

1932

A study in avian behavior to determine the nature and persistency of the order of dominance in the domestic fowl and to relate these to certain physiological reactions

William C. Sanctuary
University of Massachusetts Amherst

Follow this and additional works at: <https://scholarworks.umass.edu/theses>

Sanctuary, William C., "A study in avian behavior to determine the nature and persistency of the order of dominance in the domestic fowl and to relate these to certain physiological reactions" (1932). *Masters Theses 1911 - February 2014*. 1933.
Retrieved from <https://scholarworks.umass.edu/theses/1933>

This thesis is brought to you for free and open access by ScholarWorks@UMass Amherst. It has been accepted for inclusion in Masters Theses 1911 - February 2014 by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

UMASS/AMHERST



312066013576980

A STUDY IN AVIAN BEHAVIOR TO DETERMINE
THE NATURE AND PERSISTENCY OF THE ORDER
OF DOMINANCE IN THE DOMESTIC FOWL AND TO
RELATE THESE TO CERTAIN PHYSIOLOGICAL
REACTIONS

SANCTUARY - 1932

GOODE, J.

[illegible]

LD
3234
M268
1932
S212

A STUDY IN AVIAN BEHAVIOR
TO DETERMINE THE NATURE AND PERSISTENCY
OF THE ORDER OF DOMINANCE IN THE DOMESTIC FOWL
AND TO RELATE THESE TO CERTAIN PHYSIOLOGICAL REACTIONS

by

William C. Sanctuary

THESIS SUBMITTED FOR THE DEGREE
OF MASTER OF SCIENCE

Massachusetts State College, Amherst, Massachusetts

1932

Table of Contents

	Page
INTRODUCTION.....	1

Part I

THE NATURE AND PERSISTENCY OF THE ORDER OF DOMINANCE.....	5-84
Results of Contemporary Studies of Dominance in the Domestic Fowl Previous to 1930.....	5
The 1930-1931 Studies of the Order of Dominance at the Massachusetts State College.....	10
Confirmation of Former Studies.....	13
Definiteness of the Order of Dominance.....	15
Persistency of the Order of Dominance (Reversals).....	19
Vicious Circles in the Order of Dominance.....	21
The Formal Introduction of Strangers to the Closed Order Group.....	30
Revolutionary Changes in the Order of Dominance....	40
Relation of Physical Condition to the Order of Dominance.....	58
Relation of Disposition to the Order of Dominance.....	62
Closed and Open Orders.....	76
Summary.....	81

Part II

THE RELATION OF THE ORDER OF DOMINANCE TO CERTAIN PHASES OF POULTRY HUSBANDRY.....	85-100
An Error in the Determination of Maturity.....	85

Part II (Continued)

One Reason Why Moving of Birds Affects Egg Production.....	90
Relation of Dominance to Feeding.....	95
Relation of Dominance to the Selection of Breeding Males.....	95
The Interplay of Instincts When Birds are Driven.....	96
Summary.....	98
BIBLIOGRAPHY.....	101

A STUDY IN AVIAN BEHAVIOR
TO DETERMINE THE NATURE AND PERSISTENCY
OF THE ORDER OF DOMINANCE IN THE DOMESTIC FOWL
AND TO RELATE THESE TO CERTAIN PHYSIOLOGICAL REACTIONS

by

William C. Sanctuary

INTRODUCTION

The data included in this thesis are the result of observations made during the last eighteen years; first, as manager of a poultry plant in Connecticut; second, as an instructor in poultry husbandry at the New York State School of Agriculture, Morrisville, New York, and third, as a teacher of poultry husbandry at the Massachusetts State College, Amherst, Massachusetts. Observations were made of Barred Plymouth Rocks, White Leghorns and Rhode Island Reds.

This study of the order of dominance was due to an observation made in 1914 at the Morrisville school. That fall and in succeeding years it was noticed that a certain percentage of fully mature White Leghorn pullets would go out of laying condition within a week or two after being placed in their winter quarters. These birds were seen to spend much of their

time on the top of some window fixtures and on the roosts during the daytime. Several of these birds went into a neck molt. The cause for this was at first thought to be some lack in the ration or some fault in management.

The first clue to a correct explanation came through an incident. Four birds were placed in a show coop. One was removed. Upon returning to replace this bird with the others it was observed that a second bird had become a domineering boss of the remaining two, for each was in a separate corner trying to protect its head parts from the pecks of the boss bird. Bird number one was then replaced in the coop. She gave the domineering bird one peck. The other birds again took an interest in life and all was peaceful in the coop once more, for bird number one was a lenient boss. At once a hypothesis was formulated in explanation of what was observed. It was that all groups of birds have an order of dominance among themselves in which the number one bird bosses number two, number two bosses number three, and number one hundred is bossed by all the others. This is essentially what Schjelderup-Ebbe designated the straight-line order

and is illustrated in the first diagram of Plate I. It was inferred from this conclusion that the reason for the White Leghorn pullets going out of production was due to their low rank in this straight-line scale.

Three other observations during the next two or three years confirmed the order of dominance theory. Summer and fall culling of the early molting hens was becoming general practice on commercial poultry farms. One doubting Thomas decided to keep the flock of culled birds for a second year of laying. He did so. They laid more eggs than the selected birds. Two exactly similar instances were observed in two other states. College trained experts from three different State colleges had done the culling of these Leghorn flocks. It was concluded that the culled birds had never had a chance to demonstrate their inherited ability to lay because they had been bossed so much, by the select birds during the first laying year. Upon being separated, and having had but little drain upon their body reserves the first year, they proceeded to give a good account of themselves during the second year of laying.

An opportunity for making a detailed study of marked birds did not present itself until the fall of

1922. Pens of White Leghorns at the Massachusetts State College were then marked for study. At first tags bearing identifying figures were used. Finally, different colored spiral leg bands were tried and have been used ever since. Single bands and double bands with a neutral color separating them proved most serviceable. Although much information was obtained that fall and in succeeding years, which will be reported on succeeding pages under proper headings, a perfectly satisfactory arrangement for determining and quickly recording the exact relationship between each bird in a pen was not perfected until the fall of 1930. A record form consisting of a decagon with lines connecting each of the ten birds studied in each pen provided the missing link. See Plate VIII.

PART I

THE NATURE AND PERSISTENCY
OF THE ORDER OF DOMINANCE IN THE DOMESTIC FOWL

Results of Contemporary Studies of Dominance in the Domestic Fowl Previous to 1930. Schjelderup-Ebbe, (1922) reported his avian behavior studies of 1900 domestic fowls. He discovered, what he terms a "pecking order", to exist in domestic fowls, wild ducks and sparrows. This pecking order is a definite organization of a group of birds in which each bird has a definite number of birds which it can peck at will. He reports one such small group to have what he designates as a straight-line order of rank mentioned above. (Plate I). In such a society, one hen pecks all the others at will, the next in rank pecks all but the first, down to the last one which pecks none but is pecked by all the others.

Schjelderup-Ebbe also discovered what he calls triangular and quadrilateral orders. For example, in the triangular order, a bird, A, pecks B, B pecks C, and C pecks A. In discussing the cause of these fowl societies, he concludes from this unexpected, inconsistent order of dominance, that

strength alone is not responsible for the establishing of such a system.

Which of two hens is to dominate over the other is decided at the first meeting of the two, as a rule. One bird may yield her privilege without a struggle or she may fight for it. When a stronger hen yields to a weaker one without a fight, an explanation is necessary. Schjelderup-Ebbe cites some reasons for this. Older hens take precedence over younger ones, established birds over new-comers, healthy over the sick. The order once established is relatively permanent. If several inferior birds simultaneously attack a stronger one and defeat it, each of these will boss the stronger from that time on.

A hen low in rank is usually more cruel to those which it does boss than a hen high in the social scale. The hen which Schjelderup-Ebbe calls the A-hen, (which dominates over all the others), is generally the most lenient toward her inferiors.

The pecking order is very vital to the hens for to be high in rank assures a bird a maximum of peace, first chance at the feed hoppers, and the privilege to molest the inferiors at will.

Occasionally changes occur in the order of dominance. This is invariably accomplished by means of a fight. Such rebellions are more likely to occur when the initial relation between the two birds was determined without a struggle. The rebelling hen is said to fight with less heart against a superior than with a stranger, and therefore she usually loses. The result of such a battle decides the relative rank between the two for a long time if not permanently.

A broody hen is more easily irritated by the other hens and if pecked by a superior is much more apt to rebel. Later when with chicks she is more courageous than normally. But if her chicks are taken away from her, her courage vanishes, and any aggressor may attack and overcome her.

Serious battles which continue to the point of extreme exhaustion cause cessation in egg production temporarily or for a long time. Such battles are frequent between two "A-hens"; that is, heads of two groups from different pens.

The fighting between the males is usually more intense. Males also dominate over the females.

Schjelderup-Ebbe also makes this significant

statement: "No two hens ever live side by side in a flock without having previously settled, either for the time being, or for good, which is the superior and which the inferior".

Alverdes (1927) reports the following observations of Katz and Toll (1923). "Katz and Toll tested the intelligence of different fowls, and have established that the fowl which stands at the head of the list is also the most intelligent, and that, roughly, the position within the social scale corresponds to ascertained differences in intelligence".

Fischel (1927) makes a distinction between what he calls "closed groups" as described by Schjelderup-Ebbe and "open groups" which he, Fischel, studied. The open group is always a large group. In Fischel's study the open group contained 500 American White Leghorns in a single flock. Unlike the closed group, which a strange bird may join only by fighting for a position in it, the open group may be joined or left at will. Fischel found no indication of sub-groups or cliques within the large open group of 500 birds. Fischel attempts to answer the question why birds wish to live together socially and to what extent a group is willing to accept an individual as a member.

Fischel found the big group of 500 birds segregating into smaller groups the membership of which was constantly changing. These smaller groups in foraging in an orchard were constantly increased by new individuals and as constantly diminished by deserters. Every bird evidently had an inner urge to lead the group and in turn usually did so. Fischel calls this a competition for leadership. There is no relation between these temporary leaders of foraging groups and the leaders of the closed orders--the so-called bosses or superior birds. The sub-groups maintain a certain cohesiveness because of the universal desire on the part of these socially minded species to be in the company of others of their kind. This applies to the leaders as well as to the followers for if a leader does not succeed in obtaining a following it soon returns to the group. Katz and Toll explain a portion of this follow-the-leader action of the individuals of a group on the basis of imitation. Fischel explains it upon the basis of the inner urge of each bird to keep in the company of the others. Fischel calls attention to the fact that the *gallus bankiva* species, progenitors of domestic fowls, do not form the open groups.

Fischel, in commenting upon the introduction of a new bird into a closed group, believes the newcomer to be handicapped not so much because it is in strange quarters, as Schjelderup-Ebbe claims, but due to the rage of the excited members of the group toward any stranger.

The 1930-1931 Studies of the Order of Dominance at the Massachusetts State College. In the fall of 1930, a project was started, the chief objective of which was to determine very exactly the dominance relationships between the several birds in a pen of White Leghorn pullets and in a pen of White Leghorn cockerels for a period covering a year of laying and including the annual molt. Ten birds were placed in each pen and weekly observations were made and the forty-five possible relations between each of the ten birds in each pen recorded graphically (See Plate VIII). The order of dominance of the previous observation period was recorded on the new form previous to the observation to be made, in order that any change in the order would be immediately detected and verified. Therefore, each week's completed record contained two orders of dominance, that of that week and that of the previous observation. Each bird

was marked on each shank for instantaneous identification, (Leghorns do their bossing with great speed), with different colored spiral leg bands. Each hen had the following leg band combinations.

- R - One red band.
- R₂ - Two red bands separated by a white band.
- W - One white band.
- W₂ - Two white bands separated by a black band.
- B - One blue band.
- B₂ - Two blue bands separated by a white band.
- G - One green band.
- G₂ - Two green bands separated by a white band.
- Y - One yellow band.
- Y₂ - Two yellow bands separated by a white band.

The birds were arranged on the decagon record form in the order listed above.

Wheat was used for bait to increase the element of competition between the birds which in turn always increases the number of bossings.

Wheat was not used in the regular ration. For observation purposes a few kernels were scattered in localized areas to bring about competition between the two birds, the relation between which it was desired to determine.

The term "bossings" as used in this paper will apply to each instance where a bird definitely

caused another to retreat, regardless of whether the inferior bird waited to be pecked or not. In cases following a reversal in the relation between two birds, several positive bossings were always determined to verify the first observation. Not much patience was required in this case for the new superior bird always took great enjoyment in her elevated position and frequently bossed her new victim.

Following reversals and during general periods of numerous changes, extra observations were made, sometimes for several days in succession. Toward the end of the year when the order of dominance was relatively stable, observations on two occasions were made at bi-weekly intervals. Following the completion of the year, observations were continued for several months, at odd times as opportunity afforded.

The Leghorn pullets were housed in a pen large enough to accommodate twenty-five birds. This pen was equipped in the usual manner with grain and mash hoppers. The birds were hopper-fed entirely, no grain being scattered in the litter. There was one mash hopper, a hopper for whole corn, one for whole oats, and one each for grit and oyster shells.

The Leghorn cockerels were housed in a pen capable of holding about twelve or fifteen birds. A generous yard was attached to this, but not big enough to maintain a sod.

Confirmation of Former Studies. The results of the observations reported by Schjelderup-Ebbe, (1922), Katz and Toll (1923), Fischel (1927), and Sanctuary (1929), in general were confirmed by the 1930 studies.

1. A definite order of dominance was at all times in existence in both the male and female pens.
2. Except for a period of fifty-one days in the pen of males, the social organization always included what will hereafter be called vicious circles, as when A bosses B, B bosses C and C bosses A.
3. As a rule the dominance relation between two individuals was decided at the first meeting, with or without a fight. The result was relatively permanent.
4. Strength, age, duration of association within the group, and health are factors affecting the relation between two birds.

5. In general, low-rank birds are more malicious toward their inferiors than are those higher in the scale.
6. Rank in the order of dominance is very vital to the peace of mind of the individual.
7. Changes in the order of dominance occur from time to time, invariably as a result of a fight between a rebelling hen and her boss. Such fights are not sporting contests but are waged with the seriousness the results justify.
8. Fighting between two males is more intense than between two females.

Regarding other conclusions reported under "Contemporary Studies", above, the 1930 observations either produced no evidence, or evidence necessitating a modification of these conclusions. The latter instance will be discussed in succeeding paragraphs. Furthermore, several studies made at the Massachusetts State College from 1922 on, as well as the 1930 project, provide evidence which will be included in the discussion.

The Definiteness of the Order of Dominance. In Plates II to VII, the order of dominance is represented in terms of the number of birds bossed by each individual. For example, in Plate II on October 9th, birds B and W each bossed eight other birds; Y and R₂ bossed six birds each; R bossed five birds; B₂ bossed four birds; Y₂ and G bossed three birds each; and G₂ and W₂ bossed one bird each. But of course this does not show the forty-five dominance relations between these ten birds. To have shown all of these would have required that whenever a change in dominance occurred a decagon diagram or similar device would have had to be used. Thirty-six of these would have been necessary to illustrate the 1930-1931 studies. Plate IX shows the relations between the above-mentioned birds for October 9th. This plate shows that while Y₂ bosses only three birds, she includes in those that she does boss the hen Y, which is a higher rank hen, bossing six birds. Such inverted relations always exist except in the comparatively rare straight-line order, (Plate I).

In further explanation of these plates II to VII, it will be seen that on the days when changes in the order occur, such change is recorded in the lower part of these plates. For example, on October 23,

changes occurred involving three birds. Birds R and R₂ both bossed B. These changes are so indicated.

Graph lines on the lower part of these plates also show the weights of these birds in pounds and ounces. Egg production of each week is shown by the vertical lines. The figures at the right and left of each bird's horizontal column indicate body weights and numbers of eggs laid. Occasional observations about the birds' physical condition and molting are entered in the lower parts of these plates.

Seldom was there any doubt about the relation between any two birds. Occasionally there would be considerable toleration between some but the dominance relation could always be verified by putting the two birds in a pen or coop by themselves, or at later observation periods when for one reason or another competition between the birds became more intense. The mash or grain hoppers becoming empty two or three times afforded just such a situation. The forty-five relations could be obtained in less than fifteen minutes then, where normally it took anywhere from one-half hour to an hour for each pen. It may be added that it would take longer than this but for the fact that

the birds were expecting the bait in the shape of wheat, the few kernels of which they would rush in to get.

While it was always possible to determine the relation between any two birds at any time, and in this project an observation period was never concluded without reasonable assurance that it was correctly recorded, there were two pullets and two cockerels that had to be checked frequently. Y₂ although weighing from a pound and a half to two pounds less than Y, bossed Y throughout the period of sixteen months. During the greater part of this time Y₂ was very tolerant of Y. One would think to watch the two pullets eating together or upon seeing Y₂ leave the wheat to Y on occasion that Y₂ had concluded that her hold on her superior position was extremely precarious and that the less she put it to the test the better. This was frequently observed between other pairs. W as the boss of the entire group for the last seven months of the project would very frequently leave the center of the greatest competition, although always among the first to arrive when the wheat was scattered in the restricted areas. Both W and Y₂ were thin birds throughout the period. They had good reason for not testing their position too frequently.

However, whenever put to the test they always proved their position in the social order.

The same kind of toleration existed between the males Y and G₂ until Y became cock of the roost. In this case G₂ started out as the larger and more mature of the two. However, Y continued to improve his social position from ninth to third place. G₂ at this time had become rather thin and had been gradually forced down the social ladder. But G₂ continued to be the most dignified appearing bird in the pen, walking in a very stately manner, and usually moderate in his actions. When Y finally assumed mastery over R as the result of B's defeat by R, Y was in doubt about his position only in his relation to G₂ for a day or two. Even when the two were tested in a pen by themselves, both proceeded to use the bluff method of scaring the other into an inferior position, and except for the continuous crowing of Y after a while and the silence of G₂, there was no indication of which was the superior. There was no fight witnessed between the two and no marks of blood to indicate a struggle for superiority. However, a few days later, Y was the indisputable master of G₂ and was ordering him about in a very

positive and continuous manner, which is a very sure sign that a change in relation has occurred.

In the last paragraph it was stated that "Y assumed mastery over R as the result of B's defeat by R". This does not seem to be reasonable. It was a fact, however, and the explanation will be made later in the discussion of another principle operating in the social order.

The continued retreat by choice or by force of the inferior bird before the advance of the superior week after week together with the frequent and malicious abuse of the inferior by a superior usually for several weeks following a change between two birds left no doubt at any time about the accuracy of the social order recorded on the decagon graphs.

The Persistency of the Order of Dominance (Reversals).

A study of Plates II to VII reveal that while a given order of dominance for a group is tending to change less and less frequently as the season advances, at least upon thirty-six observation periods such changes had occurred involving in some cases every bird in the pen. The changes which occurred between two individuals will in this discussion be called reversals.

A summary of these reversals reveals that the order of dominance is less stable between the cockerels than between the pullets. The difference between the sexes in this respect is greater than Platos II to VII reveal. Of the forty-five relations existing, only four of these, or nine per cent in the case of the males remained constant throughout the period. These were: $B_2 \rightarrow W$, $R \rightarrow G_2$, $R \rightarrow Y_2$, $B_2 \rightarrow G_2$. In the case of the females, thirty-one, or seventy per cent of the relations remained fixed during the period. Three of the females were replaced on account of death, and but one change occurred after that, naturally, except for the wholesale change following the introduction of New-R into the pen, she proceeding to conquer each of the nine birds immediately and as a consequence dominating them, of course.

There is another sex difference in the nature of the reversals. Of the total reversals between males, eighteen of them, or forty-five per cent were of the one-way type. That is, there was but one change between each of these eighteen pairs. Of these eighteen, the complete downfalls of B and W accounted for thirteen of them. (See Plate X). Sixteen of the reversals, or thirty-nine per cent were of the two-way type, in which

case the original relation was re-established. Seven of the reversals, or seventeen per cent were of the three-way type. In this case a reversal occurred, then a reversal to the original relation, followed by a third reversal. In the females eleven, or eighty per cent of the reversals were of the one-way type. Two changes, or fourteen per cent, were of the two-way type. There was but one change, or seven per cent of the three-way type.

In the case of the females it would seem that an unstable relation was not worth fighting over in many cases. In the case of the males any relation with unstable potentialities had to be settled sooner or later, involving many more reversals than in the case of the pullets. But with males and females, the less frequent reversals toward the end of the year would indicate that "discretion better became the part of valor" for the older birds, and that many unstable relations had been eliminated.

Vicious Circles in the Order of Dominance. Schjelderup-Ebbe has shown the straight-line relation to be the simplest that can exist in a social group. Without question it is also the most stable. A study of the

Plates II to VII would indicate that there was a tendency on the part of both groups to approach this condition as the season advanced. From January 17th to April 8th in the male pen such a straight-line order existed. It will be noted here that when such an order exists that there is but one bird on a line. (See also Plate VIII). It is evident that this stable relation had an unstable foundation for the next month registered the largest number of changes during the entire period. One explanation for this seeming inconsistency lies in the fact that small but more mature birds succeed in establishing themselves as superiors to the larger but less mature individuals. When the latter become mature, changes are due in the order of dominance.

However, the straight-line relation observation mentioned above has been the only such relation observed at the Massachusetts State College from 1922 to 1930. At all other times numerous vicious circles have existed in each pen of birds studied. Plate IX shows a few examples of the many vicious circles that may exist in a pen of ten females, one hundred fifty-seven in this instance. These range, on October 9th, from thirteen different three-member circles, to one circle containing all ten members of the group. Such an order

of dominance may be considered very unstable.

Of the eight kinds of vicious circles in a ten-member group, it is considered that the three-member circle is the one which contains the greatest challenge to its members to break the inconsistent relation. For this reason the other kinds are of interest more from a mathematical standpoint than for having much, if any, influence upon reversals in the order of dominance.

For example, Sanctuary (1929) reported the following concerning a three-member vicious circle:

"A fascinating complication was obtained by placing a few kernels equally distant from the three birds, A, B and C. All three would rush in for the wheat, look, recognize each other and do absolutely nothing about the situation so long as all three remained equally distant from each other. But let A move away a bit and B would immediately let C know who was boss. If one of the others should move away first, the round-the-circle relationship would determine which of the two could continue eating the wheat unmolested. This was observed repeatedly, always with the same results".

While the human observer has been studying the birds, the birds have been studying each other with just what capacity of comprehension it is impossible

to state, but with much greater intelligence, it is believed, than has been usually credited to them. In assuming this premise to be correct lies the explanation why the three-member circle is so likely to end in a fight between two of its members for a change in dominance. When A observes B to boss C, which in turn has always bossed A, A by imitation, shall we say, may attempt to boss C. This has been observed many times, particularly when the bird B is in the habit of bossing C maliciously. Of course, no self-respecting bird is going to give up her position in the social scale upon such provocation, and the usual result of A's attempt is that A is given punishment in proportion to its nerve as soon as C is far enough away from B. About every so often A will have the courage to follow up her peck of C with a fight when C starts to defend her position. This may or may not end in a reversal. If a reversal does result one more cause of instability has been removed. But at once one must add that this may increase the tension and uncertainty for in conquering C, A may have been able to do so only because B joined in occasionally. If B happened to be a bird high up in the social scale and at a later date was vanquished by some ambitious social climber, its defeat

might result in her drop to the bottom of the ladder. This would now relieve A of its former handicap and C must now look to her laurels if she does not sooner or later, and probably sooner, become defeated by A.

The following is an example which may be applied to the above statement. G, a male with much courage considering his size, and well armed with long husky spurs was frequently seen to challenge W, a bird of equal size, even after W had succeeded in conquering all but B₂. Although in this instance G was being bossed by B₂(later reversed), G seemed to be able to understand that B₂ was boss of W and that he, G, had a good chance of bossing W, also. It was more than just imitation for G was constantly challenging W, regardless of whether B₂ had been bossing W just previously, or not. W always came back at G, and G never had the courage to do much more than square off for the fight before retreating. G never succeeded in dominating W, until W was conquered by B.

Another instance is worth mentioning. Although B was so much bigger than W, a pound and a half heavier when placed in the pen, and had the additional advantage of bossing W during the first few days, W succeeded in

reversing the order by November 12th (See Plate V). There was no evidence of any serious struggle. It is to be kept in mind that the first week in a pen is fraught with much uncertainty and almost any relation may be established temporarily. In this case W and B were members of a vicious circle, with the order as follows: $W \rightarrow B$, $B \rightarrow B_2$, and $B_2 \rightarrow W$. B was seen frequently to observe B_2 bossing W, and himself would occasionally square off against W, but like G did not have the courage to continue and would then retreat. However, the temptation to fight it out with W was intensified by the fact that B_2 , whom B always dominated, was constantly driving W in his presence. At any rate, on New Years Day, B must have made a most auspicious resolution for upon that day he tackled W and overcame him in a severe battle, both punishing each other badly for W was a very clever fighter.

G will again be cited as an example of a bird that makes the most of an opportune situation. When B became supreme, G's good fortune also increased. B was very tolerant of G. G was seen to keep in B's company much of the time. G was always a challenging bird, taking a chance at pecking a superior and then

facing off momentarily before retreating, or retreating as soon as he saw that his peck had not provoked any fear. B had as a particular enemy the big male R, and pecked and drove him more than any other male except W for a short while after conquering him. G was seen to drive R repeatedly when B was nearby.

The following notes made on the days of observations are pertinent:

Jan. 9. "G started to fight R, but other males rushed in. Later G bossed R away from the feed hopper. G succeeds in reversing his relation with Y. G tries out Y₂ but Y₂ calls his bluff."

Jan. 17. "G chased R after R had made a fierce lunge at G with G in full retreat three minutes before."

During the next few observations G was very busy driving W about the pen. W had been kept out of the pen for seventeen days following his defeat by B and resulting fall, to the bottom of the social scale, to see if when given a chance to recuperate he might not be able to win back his place at least over some of the more inferior birds in the pen.

Finally, G succeeded in driving R continuously as observed on March 22. It was not determined whether this was accomplished as a result of a fight. In this chaotic period, March 8th to April 3rd (Plate V), there was much evidence of fighting

in the shape of scabby combs and faces. The week following the March 22 observation, the males were let out into the yard. Coincident with this the fighting seemed to be intensified, but not necessarily due to the greater liberty for the situation had become tense, anyway. On March 27th, the following observation was noted:

"Many birds have scabby combs and bloody feathers. B is the only bird without a scratch. The birds may be placed in the following order on the basis of injuries received. B₂, G, W₂, Y, G₂, R, R₂, Y₂, and even W."

In succeeding observations G was found to be superior to R in the order of dominance, at least under the conditions existing in the group. The relation between the two might have been quite different if the two could have continued to live in a pen by themselves, the possibilities of which will be discussed in a later paragraph. It may be concluded from the above observations that G was not only an aggressive bird but was an opportunist as well.

Following are summations of the number of three-member vicious circles for the cockerels and pullets for the entire observation period: Cockerels, November 5 = 4; November 12 to December 13 = 2; December 27 = 1; January 1 to March 1 = 0 (straight-line relation); March 8 to 15 = 14; March 22 = 12; March 27 = 8;

April 3 = 10; April 17 to May 2 = 8; May 9 to 15 = 1; May 22 = 4; May 28 to July 24, the male pen was lacking a male, therefore the number of vicious circles were not counted; August 2 to 16 = 5; August 21 to September 20 = 3; September 20 = 4; October 2 to November 2 = 0 (straight-line relation); January 13 = 1.

It is to be noted that the straight-line relation existing from October 2 to November 2 was with nine birds in the pen on October 2 and with but eight birds in the pen from October 17 to January 13, 1932. For this reason this straight-line relation was not included in the previous discussion. Furthermore, the dying and removal of these birds from the pen was not discounted in the graph lines in Plates V to VII. It was assumed that the birds that died would have continued in the same relative social position if they had lived. For this reason the graph lines in these plates do not show the straight-line relation; namely, of but one bird on a line as they do show in the January 17th to March 8th period.

It will be seen that while there is a variation in the number of three-member vicious circles through the period of the project that there is a tendency for the number of these circles to decrease the longer the

birds remain together. In other words, the order of dominance became more stable.

The summary of the number of vicious circles for the pullets is as follows: September 18 = 12; September 25 to October 23 = 13; October 30 = 20; November 6 to 27 = 22; December 5 to 17 = 11; December 24 to February 5 = 9; February 14 to March 28 = 13; June 5 = 13; June 14 to 20 = 7; June 27 to August 1 = 15; August 8 to January 17 = 5.

The same conclusion regarding the pullets can be made as for the males; namely, that the number of vicious circles tended to decrease through the year and the stability of the dominance relation was increased, therefore. It is to be noted, however, that the average number of vicious circles was much higher in the pullet pen and that no straight-line relations were ever established in it.

The Formal Introduction of Strangers to the Closed Order Group. In a previous paragraph Schjelderup-Ebbe was quoted as follows: "No two hens ever live side by side in a flock without having previously settled, either for the time being, or for good, which is the superior and which the inferior". He also stated that

this order of dominance is settled at the first meeting of the two birds. All of the observations at the Massachusetts State College support these statements. The introduction of two pullets to replace two dying in the pen of White Leghorn pullets will be described. B₂ was introduced into the pen on November 29, 1930. It was first ascertained that she was not an outcast in the pen from which she was taken and that she was a bird of moderate size and in good physical condition. She apparently belonged to the large bourgeois or middle class in her pen.

The following description of what took place was taken from the notes made when she was introduced into the project pen. (See Plate XI). The B₂ there listed had died, hence the "O" entries. "November 29, 1930, 11:20 A.M. Wheat scattered on the floor. B₂, the new-comer, was placed on the floor. None paid any attention to her for two or three minutes, she going into the group to eat wheat. Then Y squares off against New-B₂ and they fight. Then B, a very nervous high-strung bird, rushes in, apparently attacking Y, but the attack was so wild that it might just as well have been both that she was attacking. Then New-B₂ faces B. B lands on top of New-B₂. Y comes over and drives B away.

New-B₂ then retreats and acts the part of an outcast. Y₂ now takes a turn and drives New-B₂. She keeps after New-B₂. New-B₂ goes up on the roost. The observer puts her back on the floor after she has time to rest. W₂ now scraps with New-B₂ and is whipping her when B again wildly rushes in driving New-B₂ away. New-B₂ is now a complete outcast to all appearances. This introduction of the new bird has made all the other birds excited. There are several near-scraps. B and Y, and B and G₂ very nearly come to blows. New-B₂ finally seeks refuge in a trap nest. W does not enter into the scrap at all".

It should be mentioned that for the first few days the pullets were in this observation pen, B was queen of the pen (Plate II). Y then fought it out with her and overcame her. Frequently in the next few weeks B would start to challenge Y, for Y was a very good natured bird, but B never succeeded in reversing the order. The situation must have been very trying to her for she ruled every other hen except Y. It is therefore reasonable to think that she, in the mad rush described above, was in reality seizing this opportunity to get an advantage over Y. If this supposition be true, she was placing her own interests above those

of the group to which she belonged. However, in taking advantage of an opportunity to defeat a hated superior she would have been behaving in a very normal manner.

New-B₂ continued to be an outcast for the next three weeks. On the December 11th observation record are these notes: "New-B₂ is not driven so much. B₂ is the only one to keep after her. She is tolerated in the wheat circle. G and G₂ drive her somewhat". It will be noted on Plate II that by this time New-B₂ had regained her lost weight and that she began to lay soon after that.

The above is typical of what usually takes place when a stranger is introduced into a pen. Few birds are strong enough to win each battle against so many opponents, for but short breathing spells are allowed, and then usually as the stranger takes temporary refuge on the roost or in a trap nest. The wild progenitor probably flew into the branches of a tree. Therefore, the chances are good that the stranger will finally land in the cellar position.

However, such a result is not universal as the following description proves. On December 24, R having died, a new bird was put into the pen to take her place. In view of what had occurred when B₂ was

placed in the pen, extra precautions were taken this time to give the stranger every advantage possible. After observing the pen of birds of which she was a member for quite a while, New-R, as this bird will be called, was chosen. While not queen of the pen of twenty-five birds, she stood high in the social scale. She was one of those mind-your-own-business bourgeois hens that was pecked by few and that did but little pecking in turn. She had tremendous potentialities for the fight ring as succeeding events proved. She could have been a Jack Dempsey but did not choose to be one. It was not worth the trouble. New-R was one of the largest birds in her old pen and was the largest bird by a half a pound in the pen into which she was placed.

New-R was placed in the observation pen. What followed is taken from the notes made on December 24, 1930 at 2:30 P.M. "None paid any attention to her at first. To see the birds one would think that not a bird was aware of her presence. She, herself, is also playing the game of bluff and is trying to appear unconcerned. Then Y squares off and the fight is on. Y is beaten. W next steps up and fights. W lets out a sharp cry as if hurt and admits defeat. Diminutive,

but pugnacious Y₂ makes a spirited attempt but is soon bested. G₂ the lover of fights (through the wire partition), makes a try. Her lack of stamina soon proves decisive. Then B comes up trying the bluff method by much talking, engages in battle and ingloriously retreats. G₂, true to form, tries again, but to no purpose. But she is not ready to admit defeat. Both combatants rest. All the rest of the birds scatter. It was as if there were a code of fighting which must be observed. In other words, New-R and G₂ had not yet settled this all important matter and it must be settled. Again G₂ starts the fighting. Both become so tired they can hardly remain standing. Finally G₂ retreats. New-R, thoroughly exhausted, now rests under the droppings board. None molest her for a minute or so. The New-B₂ now makes an attempt to get out of her cellar position, but one onslaught smashes her aspirations. G now comes up doing much strutting, but one peck from New-R makes her resume her habit of retreating. Even W₂, near outcast, must make sure she is to remain lowly in rank, and apparently got just what she expected. R₂ now tries to screw up her courage to the point of fighting. She does some talking. W joins in with a little strutting. R₂

tries to sneak up unawares but is met by New-R making only a frontal attack possible. R₂ is defeated. But she comes back again. However, it is no use. W goes up on the roost. This must have suggested to New-R that having met all and conquered all she was entitled to a bit of rest herself. Anyway, she also took to the roost. It was too soon for W to become reconciled to this new superior so she talked and strutted a bit but ventured nothing more. W jumps on the floor. New-R remains on the roost craking to herself. After a while the observer forced her back on the floor. Die-hard G₂ faces her again but painful memories caused her to retreat. New-R does much scolding. G₂ comes back again. Both scold and G₂ retreats. W₂ attempts scolding but a peck satisfies her. New-R has won against tremendous odds the right to rule that pen of birds. What kind of a queen will she be?"

The next day, December 25 at 7:00 A.M., the following notes were taken: "New-R on nest. Put her on floor. G₂ faced her. One peck from New-R was sufficient. She next pecked Y₂. B ruffled up her neck feathers in a bluff but a movement from New-R satisfied her. Then scattered wheat. All came for it and New-R ate with them. She drove G₂ away. She scolded and B

retreated. A good margin of distance is allowed New-R most of the time, one scold sending the nearest one away. All give way when New-R advances to new feeding ground. Apparently she is going to be a tolerant boss, at present merely making sure everybody recognizes her as such."

New-R had a deep masculine voice. For a long time after this the vocal threat was all that was necessary to settle all differences between her and the others. She did prove herself to be a very lenient boss, seldom being malicious in any of her peckings.

The introduction of two pullets into a pen has been considered. Two other pullets were introduced simultaneously later in the year. These two behaved as did New-B₂ when she was introduced. They occupied the two lowest positions in the order of dominance. One cockerel, only, was introduced into the male pen. New-B took the place of B, the defeated king that died soon after his downfall. New-B was chosen with some care. He was not just any male but one that had proven himself able to handle himself in the company of other males. In fact, he had on one occasion whipped B, himself, when B was king and had decided to fly over the fence to investigate the pullet pen in which New-B was then dwelling.

New-B was in a partial molt at the time of his introduction but had few or no pin feathers. He was in fair flesh and good health to all appearances. He was armed with a pair of sturdy, sharp-pointed spurs about one and one-half inches long. The observer had just finished chasing and photographing the other males in the pen. New-B was also chased until caught because he had been running free outside of his yard for sometime. New-B was allowed to rest and the other birds to quiet down. New-B was placed on the ground near the observer. He ran away from the observer. Dignified G₂ now low in the social scale, started after New-B first. New-B fled to a corner. Then he ran to another corner with W, (lowest rank), after him. Next he tried to fly over the fence. During this running about he was emitting a cry almost exactly like that of a hen craking just before she goes on the nest to lay. The other males were crowing loudly. In the intervals when he was permitted to walk about the yard unmolested, he continued this craking. The observer had never heard this or any other male emit a sound like this before (this male had been in the pen of observed pullets during the breeding season). The craking sound considered apart from the situation would not have indicated fear. It

was not hurried. It was incessant. When other males approached him he would change the craking only in pitch and crescendo. The other males drove him and flirted with him as males do with others they domineer over, or are trying to bluff, or as they do with females. He continued the craking for a week. From then on he was just an inferior male. Needless to say New-B accepted the dominance of all and remained in that position until September 20, when he succeeded in overcoming G₂ a short time before G₂ died.

Schjelderup-Ebbe reported. (1922) that a strange hen was entitled to whatever position she could win for herself. Judging by the results of these introductions of White Leghorn males and females into pens, the chances would seem to be limited for the most part to either one of two positions, either the top or the bottom, with the chances very much better for the lowest position.

It may be said that the introduction of a new bird into a pen was not in these instances accompanied by a haphazard free-for-all mob struggle but was on the contrary a rather orderly process with what might be called a certain code of honor being observed by most if not all of the birds involved. Such a process might be

expected to be associated with the very exact and definite order of dominance in these avian social organizations.

Revolutionary Changes in the Order of Dominance.

Revolutionary changes in the order of dominance may be brought about in two ways. In the first place if, upon the introduction of a stranger into a pen, this newcomer succeeds in dominating the entire group, a drastic adjustment in the social order is involved. Furthermore, if the alien has a domineering disposition the consequences may be far reaching. But a discussion of this type of revolution has been discussed under the topical heading, "The Formal Introduction of a Stranger to a Closed Order Group".

A second type of revolutionary change occurs when a ruler of a group is deposed and finds itself at the foot of the social scale. While this is likely to be less disastrous to the group than the first mentioned type of revolution, to the individual involved it is likely to be more disastrous even than to the stranger which lands at the bottom of the social ladder upon its introduction to a group. The revolutionary change involving the dethroning of an avian king will be con-

sidered here.

The first such revolution occurred in the fall of W. W was only near-king at the time for B₂ always bossed him. In fact, as Plate II reveals there was no king of all the birds in the pen at that time, January 1, 1931. B which already bossed B₂ had but to conquer W to reign supreme in the pen. On New Year's Day he accomplished this. It was a fight to the finish, judging by the appearance of the birds, and the description of it by some of the plant attendants. Because the battle was so severe and W so thoroughly beaten, all the other birds in the pen took advantage of the situation and at once proceeded to impress the fact upon W that they, too, were his master. In his physical condition, his comb and face were a mass of blood, he was in no position to defend himself against them and therefore he became an outcast. To be an outcast in a pen of males and in such physical condition means to be in danger of losing one's life, for if the abuse from being bossed around does not result in death, the attempt on the part of the other males to tread any male which they can get down on the ground may so result. It was, therefore decided in this case, to see if, upon being given a

chance to recuperate in a coop by himself in another building, he might not regain a portion at least of his lost standing in the social order. Of course in doing this it was recognized, that unless the memory span of the other birds was sufficiently great, upon his return to the pen he would be regarded as a total stranger and would be no better off in the order of dominance for having been removed. However, it was decided that his life might be spared, anyway.

The following method of trying to recoup W's position in the order of dominance in the pen was resorted to. On January 2, the day of his defeat, it was noticed that W₂ had rushed W repeatedly. Now, W₂ was an effeminate acting and looking male (See Plate XIV), that had been more often abused by other males in their attempt to tread him than was any other male in the pen. He was low in the order of dominance, too (See Plate II). It was therefore concluded that his sudden demonstration of malicious punishment of W was due to his desire to improve his station by firmly establishing himself as the superior of W while W was in no condition to resist. In other words, the cowering W, in the presence of his many temporarily, yet collectively-superior pen mates was an invitation to W₂ and the others to wreak vengeance,

or to kill in the excitement of such a situation or to merely make sure that they were going to be able to boss him from then on. Possibly a combination of all of these urges was inherent in the situation.

To test the relation between W and W₂ with the mob-situation removed, it was decided to take W₂ and W and place both of them in a strange place, the grain room floor, and thus equally handicapped, except for the severe beating W had received the day before, to let their actions reveal the real order of dominance between them. Wheat was placed on the floor as usual. W was hungry and began eating it. W₂ stood still. W then discovered W₂, gave one challenging cry and W₂ retreated to a place underneath a grain bin where he remained.

Next, B was brought in. As long as B remained in the hands of the attendant W was strutting around uttering the challenging cry. As soon as B was placed on the floor B uttered his challenge and W at once became the inferior bird for he began looking for some high place to fly to and finding it, flew up on top of some retention coops. B, however, did not venture to chase him but began eating the wheat. Conclusions are evident in this case.

Next G was brought in. W immediately became the challenging dominant male proceeding to circle G in the usual courting action preceding the next steps in a fight. G retreated. G was a good bird with which to test this relation for he was a very aggressive bird often challenging W. But there was not the least sign of a challenge in his demeanor now. And the day before he had participated with the rest in abusing W.

Next R was brought in. R at this time weighed two pounds more than W and later became ruler of the pen. The following description of what took place is taken from the notebook.

"R was placed on the floor. Both birds tried to scare the other by courting and uttering the challenging cries. That failing, W attempted to peck R. R dodged and faced about for the fight. They went at it. It then became apparent why W had remained so near the top in the order of dominance for so long. He was very quick in his motions, flattening himself to the floor and sidestepping the rushes of the larger R, at the same time getting in several blows to R's comb and wattles, starting them bleeding. Both became tired. R's greater weight caused W to do the backing up except when the two lunged and jumped at each other in the

typical cock-fight manner. Realizing the handicap W was laboring under the two were separated before a decision could be made. Upon picking up the two birds it was found that W had not received a scratch while R was bleeding in three places".

On January 3, R was again matched with W, for it was desired to return W to the pen before he became an utter stranger to it and the birds in it. The same order of events occurred as the day before, W starting the fight, and inflicting the greater amount of punishment. The fight was allowed to continue this time, however, until W became so exhausted he retreated under the grain bin.

W was then given a chance to rest for several days. On January 8th, R was matched with W for the third time. W immediately started crowing and started the fight with R by jumping clean over him. Then R jumped over W. Then both met in mid-air several times. Neither was able to get a hold on the other. Suddenly R stopped fighting, his tail drooped. The fight was over. W was the victor.

So far so good. It began to look as if something were being accomplished in the attempt to

rehabilitate W in the order of dominance of that pen of males. A mistake was probably made here for after giving W a rest, B, his conqueror was brought in. The rest should have been longer, perhaps. But probably it would not have made any difference, anyway, for B was not only a big bird but also a clever fighter. B was declared the victor after W got tired and retreated. Neither had inflicted punishment of a visible nature.

W being still underweight was now put in a pen of pullets where he would have more room for exercise. It was also thought that being in a harem where he would be lord of all that he surveyed, might help.

On January 17th, W and B were again tested. B was very aggressive this time. They fought for two minutes, then retreated. After a rest W was tested with R again. Both were scared of each other, but W went into the corner. Was this unsatisfactory outcome due to W's sojourn with the pullets? It was considered useless to try longer to improve the status of W. W was returned to the pen of males. It was apparent that in the group W was practically an outcast. On the next observation period, January 24, W's position was definitely that at the bottom. Again his comb was bloody. He was placed in a broody coop in the pen with some feed. The

door was left open so that he and the others could have access to it. A week later there was no more blood on W's comb and he was being tolerated to the extent of being able to eke out an existence. He was still very much the outcast. He spent most of his time on the roost. Not until February 14th did his weight return to normal, by which time he was being treated with much more tolerance.

On May 3rd, B and R had a fight, worse if anything, than the one occurring between B and W. This was observed by two of the plant attendants. R conquered B and B became a complete outcast as W had become before. R did not become pen boss by this victory, however.

The following morning at 5:00 A.M., another observation was made. The attention of most of the males was toward the defeated B, which was driven from one corner to another, he spending most of his time on the roosts. R, too, was receiving his share of attention. Several males challenged him, but when he squared off to fight, they retreated. Of course he retreated as usual from those that had been bossing him previous to his fight with B. He had three such superiors. To see them go out of their way to boss him one would think that they were doing this to let him know that even

though he had conquered B, they were still his superior.

For several days afterwards, B would try to regain some of his standing by fighting some of his oppressors. But it was too much for him. He was removed from the pen to save his life.

At this time the situation was most tense. The birds were in a very excitable condition, challenging each other and some engaging in minor fights. Anything could happen. The birds were weighed on May 4th. The drop in weight of every one of them indicates the strain under which they had been (Plate VI).

By May 9th, the situation had become a bit more settled. Y was confirmed as pen-boss. It is to be noted that Y was very much more aggressive toward R than he had been previous to R's fight with B. He seemed to sense that this was necessary.

The question may naturally arise how a bird of Y's size and build (Plate XIV) could reach the top of the social ladder. Y was always a very high-strung bird. He was the noisiest bird when the birds were being caught and weighed. He had one habit which perhaps was largely responsible for his climb from ninth position. He would make sudden dashes at other males,

sometimes from the rear, invariably without warning. He would immediately retreat as was necessary, usually, after the assaulted bird had gotten over its surprise. His unexpected lunges were almost as frequent toward his superiors as toward his inferiors. He was never seen to put up a real fight with another bird, until later in his big fight with R, when he was defending his position as king.

On July 10th, the following note was made: "Y does not seem quite so aggressive". For some time a cankerous growth had been increasing in size on the inner side of his lower mandible. He could not close his mouth tight. A few days previous to the August 2nd observation, R and Y had a fight for mastery. Evidently R defeated Y, but in doing so in some way had gotten bloody and thus got the rest of the birds after him or the mob action may have been spontaneous. At any rate, when the attendant rescued R he was plastered with blood and two or three birds were hounding him on the roost where he had gone to get away from them. But for this rescue, R would have in all probability gone to the bottom of the social scale or would have been killed outright. There are two reasons for thinking this action on the part of the other birds was not due to any great punishment

from Y. In the first place, with Y's beak in the condition it was in, it is doubtful if he could have inflicted very much damage against a bird of R's size and aggressiveness. In the second place, R was one of the meanest birds in the pen in his bossing of others. If birds can hold grudges against others they certainly would have done so toward R.

A few days later R was returned to the pen. For quite a while he spent most of his time on the roosts. He was, however, undisputed boss of Y, but was afraid of the group. Here was a bird which was observed to boss every other bird in the pen individually but which was afraid of the group. By August 21, his fear of the group had vanished and he was at last the domineering boss of the group as well as of each bird individually.

One more observation should be made regarding the downfall of Y. Unlike W and B, Y did not immediately lose all caste in the order of dominance following his defeat by R. In fact, only two other birds besides R succeeded in taking advantage of his defeat at the time. They were B₂ and R₂ both aggressive birds. The explanation seems to be that Y knew when to quit. This wisdom or fear, or whatever it may have been was

responsible for the saving of the greater part of his social position if not his life. Or it may have been fortunate that his aggressor was so much hated by the rest of the birds in the pen. Y had incurred no such enmity even though he had been in the habit of making the occasional, sudden attacks on the other birds. As boss bird he made few of these except upon R.

These three revolutionary changes in the order of dominance would probably have caused the death of a bird in each case but for the interference of the caretaker. They were associated with much excitement, much fighting, and usually some loss in body weight. They were followed by an increase in changes of dominance relations between other members of the group. But much of the change in the order of dominance was due not to the relative merits of individual pairs, only, but in some cases chiefly due to the circumstances of mob action as tested in the case of W. However, no matter how it came about, the order remained rather permanently as the continued low position of W for the rest of the year proved. The revolutionary change of this type, the dethroning of an individual, was confined largely to the males.

The effects of introducing strangers into a pen have been described. It was concluded from these observations that the introduction of a single bird into a pen was apt to result in that bird occupying the lowest social position. Two other introductions, really re-introductions, will be described.

First, sometime between the observation of May 28th and that of June 5th, G₂, the bird with the mean disposition, got through the door into the adjoining pen, now empty, except for feed hoppers and water. She was returned to the observation pen on June 5th. Little Y₂, much bossed by G₂ started to fight with her but lost. W₂ stepped up and gave her a peck. G₂ was the only bird that W₂ bossed until New-B₂ was introduced. She must not lose a half of what little social position she had. Next, R₂ pecked her. Y₂ tried again but lost. W also pecked her. G₂ had challenged W many times before but never fought with her, so far as the observer knew. B seemed to remember her and kept out of her way. B had been viciously hounded by G₂ since February 14th, when G₂ succeeded in reversing the order between them. Then G₂ faced W₂, something she had not dared to do before. But Y stepped up and drove her away. This latter incident

is another indication of the great odds the stranger labors under. At the end of this observation period it was uncertain just where G_2 would stand in the order of dominance. Her disposition was counted upon to assist her materially (Recall her frequent attempts to overcome New-R when the latter was introduced into the pen). The next period, June 14th, proved that she had suffered but one reversal--that to R_2 . It was difficult to explain this phenomenon. Was it possible that some of these birds had forgotten the identity of G_2 ? Had she, herself, forgotten W_2 as a superior bird? Was there some understanding among a group that would not tolerate the absention of a member of it? Was it just a bit of opportunism on the part of Y_2 and R_2 ? Was she a semi-stranger, stranger to some with short memories but not to the others?

No sooner had G_2 taken her unprofitable sojourn from the observation pen than New-R did the same thing. Sometime during the week following June 14th she left. On June 20th she was put back. Unlike G_2 she proceeded to establish herself without any fighting or any considerable threatening. Her deep voice seemed to be sufficient to re-establish her in her position

as queen. But in view of what had just happened to G_2 was it possible that she had not been out of the pen as long as G_2 , therefore, the memory span of the birds was sufficient to save New-R the embarrassment that had been G_2 's? Or was it because of the sound whipping which New-R had given to each member of the group upon her introduction to the group: and the constant reminding them of her position: and the association of these with her masculine voice that made her unforgettable? It was decided to test this out. Following the completion of the observations, New-R was again placed in the adjoining pen which was still empty.

One June 26th, New-R was placed in the observation pen again. Following is a description of what occurred. She will be designated simply as R here. She mingled with the other birds as she did the week before. She ate some mash. Then the same sort of a performance occurred as on December 24th, when she was first introduced to the pen. She fought B_2 , winning. Next she did the same thing to G_2 , former chief rival. Then she won over R_2 . W next tried it out and succeeded this time. This is the first defeat that R ever had in this pen. R retreated to the drinking fountain. Y_2 tried a hand,

but it was indecisive. W drove R. (Where there was no fight, as in the last instance, the record will be simply "W → R"). W kept at it (very typical). G → R, (a big accomplishment for G). W → R, pecking her frequently; R took refuge under the nests. W drove her to the roost. Wheat was put on the floor. R came down to eat. W drove her under the droppings board. W drove her out. R jumped up on the fount stand with Y₂. R scolded Y₂ and Y₂ retreated. R continued scolding from the fount. G flew up and drove her down and kept after her. R scolded G₂, but retreated when G came up. R went under droppings board and craked as if nothing had happened. (Is this a fear cry? Recall instance of New-B in the male pen). She did not give any threatening cry. Put wheat under droppings boards. R came out. W₂ scolded R but retreated. Y → R; G → R; W → R. There was quite an interval of inaction. R → B₂. R was in the sun alone. Wheat put there. R scolded. W → R. R flew to the nest perch. Back to the sun. Y → R. R to the nest perch; to roosts three minutes; down for wheat. G and R scolded each other; they fought; R retreated. The male trod R. W₂ and R fought, indecisive because Y came up and drove R. W₂ was getting the worst

of it but seemed to realize the moral backing she had and kept at it until Y came to her rescue. Another interval of inaction. More wheat on floor. R ate until W came, then retreated. $Y \rightarrow R$. R fought with G_2 and conquered her. $R \rightarrow B_2$. This is more than W can stand. $W \rightarrow R$; $R \rightarrow B$ (B is very much out of condition now). Rooster trod R again. $R \rightarrow Y_2$; $W \rightarrow R$; $W \rightarrow R$. W_2 scolded R but did not fight. Y_2 tried attacking R from the rear but lost. W_2 and R scolded each other but $W \rightarrow R$. W_2 and R again scolded but again $W \rightarrow R$. R_2 and R scolded. W_2 fought R again but indecisive for again $Y \rightarrow R$. W_2 and R scolded again but $G \rightarrow R$. R went to the roost, quite an outcast because of the hounding by W, Y, G and the continued attempt of W_2 to win over her. The next day R and R_2 had decided their relation in favor of R. Also W_2 , probably with the continued backing of R's new bosses, had made a decision, this time in favor of W_2 . Imagine the joy of a next-to-an outcast winning over a bird like R! But it was a dear victory from the poultryman's point of view for notice what happened to the egg records of W_2 , W, Y, G and R (Plate III). Succeeding observations established the fact that R had become an inferior to the four birds

W, Y, G and W₂ as the result of her sojourn away from the observation pen for a period of less than two weeks. Was this due to the shortness of the memory span of some or all of these birds? To all appearances they behaved toward R as they did when she was first a total stranger to them. And she behaved toward them as she did on the first introduction to the pen. Each of the birds found it necessary to try out the dominance relation with her, either by scolding, bluffing or fighting. It was fighting in most of the cases. They even forgot that raucous deep voice of hers and she used it much during the formal introduction!

However, in this case, because of her size and prowess and a number of very circumstantial conditions, as can be seen from the detailed description, the order of dominance re-established did not result in her going to the bottom. It is to be noted that with but one or two exceptions the birds did not fight as strenuously this time as they did at R's first introduction. Was this due to the male's presence this time (he was not in the pen before), or simply because getting older made them wiser and less ardent to fight for the social advantage if it were going to cost too much in punishment?

The Relation of Physical Condition to the Order of Dominance. Schjelderup-Ebbe's findings regarding the factors affecting the order of dominance have been cited above. Briefly, they are age, strength, the handicap of being a stranger, condition of health, broodiness and bluff. Although the numbers are not large the observations made at the Massachusetts State College verify all of these factors except that of broodiness. That was not studied.

Of course there are individual exceptions to all of these. But such will not be considered here. There is one consideration that should be given weight, however. That is that factors that may be all important in the establishing of a given relation between two birds may have but little weight in maintaining or changing such relations later on. The cases of the reversals of B and W males and the near-upset (but for the intervention of the caretaker) of the male R are examples. Here the mob action was paramount in the situation.

While maturity is very important in establishing the order when birds are first put into the pens, this difference soon disappears as the immature birds become of stature. This early, unbalanced

situation is one of the chief causes of the vicious circles and the numerous upsets that occur during the first half of the year. It is especially applicable in the case of the males.

Health, size and strength, treated here together, are very important in establishing relations, but once established may be but of minor importance, short of near death. The original B₂ continued to boss the same five hens almost to the day she died. She had been gradually getting weaker and thinner from paralysis and during the last week could but little more than drag herself around the pen. But not once did any of those five birds inferior to her, attempt to boss her. B, in the same pen, gradually slid down the social scale until she died. It is to be noted that while she dropped in weight from a maximum of five pounds to about three and one-half pounds, that up to a few weeks before she died she continued to boss two other birds in the pen. She was then removed to another pen. G₂ in a similar manner held onto his social position while gradually losing weight and continued to boss a few up to within a few weeks of his death.

There are other factors important in establishing a given social relation between two individuals. Cleverness and quickness in the fighting are important. The case of the clever W in his fight with the big R is a good illustration. The clumsiness of big B₂ in his numerous fights with birds of smaller weight like G, G₂, Y and W₂ is another case.

The condition and effectiveness of offensive weapons are also important. Males, only, will be used to illustrate this factor. The following males were especially well armed with spurs: R, G and W. All of these had sharp spurs and most had spurs longer and stronger than the average. Y and B had sharp ones but theirs were not quite so long. The spurs of G₂ and W₂ were decidedly inferior. Possibly the condition of the beaks is even more important. When G₂ and B₂ had broken off the tips of their upper mandibles they began sliding down the social scale the most rapidly. On March 27th, the broken mandibles were first observed and recorded. Y slipped from the pinnacle following the cankerous growth in his lower mandible. Then he broke off the tip of his upper mandible. He continued to fall in the social scale from then on. He resisted stubbornly each time he was challenged but was wise

enough not to fight to the point of exhaustion.

Another factor, the sex urge, which in itself may not be responsible for a change between any pair of birds, is nevertheless provocative of many a challenge and sometimes a fight for supremacy. Beginning with the advent of warmer weather, the last of March and the first of April, this sex urge was manifest in the increased number of attempts of the males to tread each other. As has been mentioned before, W_2 was the outstanding victim of this treatment. However, he also would attempt the same on the others. The surprising element in this situation was the manner in which inferior birds would attempt to tread their superiors. Some of the lowest ranking birds would attempt this on some of the highest, and in some cases upon those which had a particular grudge against them. The consequences of such rashness can be imagined. But the memory of the punishment was short-lived and they would be attempting it upon another bird soon after, or upon the same bird, before the observation period was over. Of course this caused much excitement and occasionally a fight. The fights were very few in comparison to the number of these treading attempts. However, Plate V reveals that the greatest number of

changes in the order of dominance was approximately coincident with this increase in sexual activity.

On the basis of the observations made at the Massachusetts State College the several factors affecting the order of dominance might be arranged in the following order according to importance. Inherited dispositions, cleverness in fighting and fighting equipment, body size and strength, maturity and health (short of a fatal illness). This order is based upon the assumption that the birds have been hatched during the same hatching season; have been reared on the same range with the same rations; and have been housed at the same time. This places much importance upon the factor of inheritance. The question of the birds' dispositions and the indication that they may be inherited will be discussed next.

The Relation of Disposition to the Order of Dominance.

Sanctuary (1929) reported that disposition was a factor in bossism. At that time the following was reported. "A hen's disposition may not only determine the whole of its future usefulness to its owner but may also profoundly affect the welfare and contentment of its pen mates". Again, "There is much toleration of each other

among many individuals which as groups might be called special privilege groups. As a rule, these birds constitute a rather large percentage of most pens".

"But between other individuals there exists no peaceful relations whatsoever. The boss always pecks at or drives away the bossed. In some instances the boss frequently goes out of its way to drive its object of hatred. In many instances extreme viciousness is exhibited. It would appear that long-nurtured hatred was involved. When the extreme form of antagonism is exhibited, such as when a boss goes clear across the pen to drive its victim, it would seem as if it were doing so to make up for the time when it was on the receiving line and that it wanted to make sure that the present ranking should not be forgotten".

"First, there is a small group of birds among the upper '400' that are born fighters. Seldom do any other birds take issue with them. Second, there is another small group at the other end of the social scale that have been called the "outcasts". These are everything that the name implies. Social misfits is an inadequate term for them. These birds expect trouble at every turn and they are seldom disappointed. Often these outcasts may be recognized

by their behavior when first put into the laying quarters, so well fixed has this mental attitude become while they were on the rearing range. The same may be said of the super-belligerents among the '400'".

"Third, the large group in most pens, making up more than half of the birds, may be said to mind their own business most of the time. Of course they have their places in the ranking system, but they carry their honors modestly even if relatively high in the order. If they occupy a more humble station, they do little advertising of that fact. This middle class of the hen community are not seekers of trouble and as matters stand in the avian social system, get mixed up in but little. It is this large middle group of birds that makes living conditions possible in the poultry-man's pens. With the tendency to crowd the birds more and more, the value of this group of birds becomes enhanced".

The 1930-1931 observations have corroborated these conclusions reported in 1929. A few illustrations will not be amiss. First, will be cited observations made on a pen of White Leghorn pullets observed in the fall of 1926. The first observation was made on the

afternoon of September 17. That morning twenty-six Leghorn pullets had been brought in from the range for this pen. They remained in the shipping coops until after luncheon. They were as a consequence, very hungry. As soon as the birds had been weighed and banded, the first observation was made. It was immediately noticed that Y₂ was queen of the pen and a very imperious one. She proceeded to take charge of the one mash hopper, permitting no other bird to eat from it. Many tried, because of their hunger, but were pecked so violently that they retreated. Finally, her appetite satiated, she proceeded to walk toward the other side of the pen. This was followed by a rush to the mash hopper. But a few mouthfuls were obtained, however, for Y₂ returned and drove them all away. She then pecked at the mash in a fastidious manner, then left it again. Again the rush to the hopper by the others and the same return of Y₂. A little later she left again and went to the other side of the pen for a full thirty seconds. But the sight of the other birds eating "her mash" was too much for her and back she came and drove them away as before. Eighteen times this performance was repeated. Toward the end of the hour she remained away for a little

longer time. This permitted one bird to get fifteen to twenty mouthfuls, but she earned it with the pecking she received from Y₂ before she could get out of range. Upon leaving this pen to observe another, a fellow teacher came along. He became interested in what was going on and watched the pen for fifteen to thirty minutes. He reported a continuation of Y₂'s tactics.

The following are notes taken verbatim from the observation record forms:

"September 18--4:35 to 5:15 P.M. Y₂ is at the same game, keeping all the others away from the mash hopper".

"September 21--10:25 to 11:05 A.M. Y₂ at the same tactics at the mash hopper".

"November 26--2:15 P.M. Y₂ started to scrap with the rooster which had driven a hen away from the mash hopper. The male proved to be equal to the occasion, however. Apparently Y₂ thinks she owns that mash hopper".

The above is admittedly an extreme example, not of a hen's disposition only, but of the combination of that kind of a disposition with the social position which she occupied in that pen. One would naturally expect that such a condition would have its effects upon the egg production of such a pen. It did.

The disposition of the White Leghorn pullet described above might be classified as a very jealous

one. Another type of disposition will be described among the males. This spring (1932) all the breeding male candidates in what is called the "Bull Pen" were weighed and judged for condition and standard points. These males had been together since last fall so that no situation such as Schjelderup-Ebbe describes when A-birds from two different pens are put together existed in this bull pen. Upon dropping one male, a Rhode Island Red, on the ground after weighing him, it was noticed that he and another Red male started to fight. About ten minutes later it was noticed that the two were still fighting and that both were much exhausted. This was just before luncheon. Upon returning to finish the task right after the meal, one of these males, easily recognizable from his coloration, lay dead upon the ground. It is not known whether he was killed by his opponent or simply died from exhaustion and the attempted treadings of the other males. Low ranking males frequently suffer this indignity in a bull pen. The fact remains that because of his stubbornness, his never-give-up spirit, he had to lose his life. Such a disposition among domesticated birds is all out of harmony with the economic business of poultry keeping. It is a requisite in the pit.

An illustration of the typical disposition of the bourgeois or middle class birds, described above, was White Leghorn female W in the 1930-1931 project. Although always a high ranking bird, and finally becoming queen, she was one of those busy, alert but mind-your-own-business types of birds. She was always avoiding trouble and possibly might have been obliged to resort to more bossing but for her alertness; she was always among the first to arrive at the spot where the wheat was thrown. She did, however, take delight in driving W₂, but with little evidence of maliciousness, usually. She also drove G and G₂ occasionally. She almost never bossed any of the others with the exception of New-R, and even in this case the bossing lasted for only a week or so after the relation had been reversed between the two. In the case of W₂ the element of revenge could not be considered for W₂, from the first day was almost an outcast and never had dominated over W. W would have had more reason to peck G₂ for G₂ had one of the meanest dispositions of any bird in the pen. If G₂ had been able to climb to the top she would have been a second Y₂ of 1926.

Two kinds of disposition have just been des-

cribed and an attempt made to classify all hens into super-belligerent, bougeois and outcast classes. While it is true that most hens will fall into these main divisions, the reasons for any one bird being in a particular class may be one or several of the factors apart from the disposition of the bird.

A rat is courageous when cornered. The normally good natured hen may be a fighting demon when a stranger is introduced into the pen and her social position is at stake. A hen with a jealous, vindictive disposition may give no evidence of hervitriolic potentialities if she happens to be at the bottom of the social ladder. As Schjelderup-Ebbe states the broody hen is more courageous than normally but loses all her courage if her chicks are taken away from her. A hen in an emergency is also more courageous than usual. Hen W₂, practically an outcast at the time, bossed Y in no uncertain terms when about to lay an egg on the floor. Therefore, unless one is well acquainted with the birds they are liable to be mis-labeled for an individual may exhibit one kind of a disposition under one set of circumstances and quite another if the conditions are changed. The parallel to a study of human dispositions is quite evident.

Granting these difficulties in classifying fowl dispositions, nevertheless a description of one or two outstanding characteristics of each of the 1930-1931 cockerels and pullets studied will be made and the family relationships included. All but one of the birds studied were from pedigree matings. Furthermore, a special precaution was taken to prevent any bias creeping into the description of these birds' dispositions, for not until after the project was completed were the family relationships determined. Therefore, the descriptions here presented were taken from the observation record forms as made in the pens without any knowledge of the ancestry of the birds.

The first family contained R_2 , and W, males; and the original R of the pullet pen. R_2 is described as being very courageous in battle. W has been discussed at considerable length already. He is described as being "peppy", "cocky" and "clever". He was courageous. R, the sister of these brothers is described as "being quite a scrapper", and "bosses several severely". She was at this time making a struggle for a better social position. She died early, therefore was not so well known as the others.

The second family contained one male G, described as having "much nerve" and as being a great "challenger". R₂ one of his sisters was "very courageous in battle when getting the worst of it". She was a great challenger through the wire partition. Schjelderup-Ebbe's observations indicate such birds (challengers through partitions) are not bluffers but always willing to fight for their social position in a group. The other sister, G, was described as a "real boss of those she did boss". This is not very illuminating. She was "very alert". Note the challenging characteristic of the male and one of his sisters.

The third family contained one male Y, already discussed. He was described as being "the most high strung bird in the pen". He had the habit of making unexpected rushes without warning. This habit saved his position against W on the day of the last observation. His sister B has also been discussed. She was described as being "the most high strung bird in the pen". Both she and her brother were No. 1 birds in their respective pens for a while. As such, they were both challenged frequently by inferior birds. They were both tolerant bosses.

The fourth family contained male G₂, described as dignified, courageous. He held a high position until blinded in one eye. His sister, the original B₂ was described as "spunky", "courageous" "very cocky toward those she does boss".

The fifth family contained W₂ and was described as being effeminate in looks and actions. He was a large bird and when he became mature he exhibited much courage, tackling and overcoming R, a real accomplishment. Many inferiors challenged him. He was one of the mind-your-own-business, bourgeois types. His sister, Y, was a bourgeois pullet, very tolerant of her inferiors and frequently challenged by inferiors but never successfully.

All of the above families belonged to one strain of Leghorns. Those below belonged to an outside strain brought to the college plant two years before. They represented the third or fourth generation of the intermingling of three Pacific Coast strains of Leghorns.

The sixth family contained one male, B, courageous, wise, and a very tolerant boss of all but R. He was not particularly vicious toward him but kept reminding him of his place. W, his sister, has

been discussed. She was described as being a very tolerant boss, avoiding situations provocative of trouble. She was very aggressive when establishing a new position over a rival--a wise precaution. She did enjoy keeping W₂ on the run and maintained this habit all through the year. New-B, a male, brother of original B, had no opportunity as cellar member of the pen to do other than give the strange exhibition of the craking hen. New-G₂, a sister, was, like New-B, put into the pullet pen too late and was too near the bottom to make a disposition study possible.

The seventh family contained R, described as the most domineering male. He made life miserable for those he bossed, which meant the entire pen when he finally became established as king. B₂ was his full brother. The similarity in body conformation may be seen in Plate XIV where the two are standing close together. B₂'s disposition was similar to R's. He is described as being "jealous of others eating", "determined to get R", "fought much but not very successfully". They had as a sister, G₂ which was described as being the most domineering pullet in her pen. She fought much as has been described above, but not very successfully. She was very courageous. She had

two sisters, New-B and New-B₂. New-B₂ never exhibited any courage worth mentioning. She was unusually domineering over B when she succeeded in making that reversal. New-B was introduced into the pen so late that but little about her could be learned. She also occupied the cellar position which made matters still worse for such a study.

W₂, the typical outcast of the pullet pen had no full brothers and sisters in either pen. She did have the same sire as males Y, G₂, and W₂ and as did females B, original-B₂ and Y.

Male Y₂ and female Y₂ similarly had no full brothers or sisters in these pens. New-R was an unpedigreed pullet.

A study of these families indicates that certain traits of disposition may be inherited. The challenging habit was very evident in two of the three members of the second family. The two members of the third family were outstanding in the nervous temperament which they possessed. The fifth family had in male and female the tolerant disposition which other birds tried to take advantage of. The sixth family contained birds that were tolerant and in the case of two of

them were well able to take care of themselves. The same might have been true of the other two members of the family if they could have been observed in the pens from which they were transferred. The seventh family possessed two members, brother and sister, which had the meanest dispositions of any in the male and female pens, respectively. The other members of this family, so far as it was able to get information about them, harmonized fairly well with the first two described. In conclusion, it may be said that from the standpoint of poultry-keeping on a commercial basis, the following families possessed desirable traits of disposition: the first, possibly the second, possibly the fourth, the second and the sixth. The third and seventh families were exciting, unstabilizing and vicious elements in the pens. The effect of such elements upon the peace and contentment of their pen mates must be conducive to irregular and reduced egg production, in the case of the females.

Before a mode of inheritance of fowl dispositions can be investigated it will be necessary to first be able to classify them. It is not claimed that the above description of the members of these families affords any basis for such a classification. However,

it may serve as a beginning. There certainly is an economic application waiting if the mode of inheritance of these avian dispositions can be analyzed.

Closed and Open Orders. Fischel (1927) has already been quoted as making a distinction between open and closed orders upon the basis of the size of the flock. The observations at the Massachusetts State College add but little to Fischel's conclusions. It is to be noted that he based his observations upon a very large unit; namely, five hundred birds in one flock. It is possible that in so large a flock that birds could enter it without going through the formal introduction process such as is necessary when a bird enters a closed order (small) flock. The basis for this may well be the limits of the capacity of the individual bird to remember so many other birds. Which bird is a stranger in so large a group?

However, these comments based upon observations of pens of Reds, Barred Rocks and Leghorns (largely Reds) are pertinent. In pens up to two hundred birds in number, bossings among the birds is going on, apparently to the same degree as in the smaller pens. It is possible that these bossings may be of a hit-and-

miss character and that no exact order of dominance is present as in the case of the small pens reported above.

As an illustration of the frequency of bossings in a large pen, the results of a short study in the winter of 1927-1928 are presented. Several pens of Reds, Rocks and Leghorns were watched and the number of bossings observed. In this case only the pecks that landed on the receivers were recorded. It was found that each bird in the pen received ten pecks a day on the average. Assuming that the observers missed at least half the peckings (these were pens of from one hundred to two hundred birds each), and that probably one-third of the birds received two-thirds of the pecks, it can be imagined what life is like, even in a good-sized pen, for the "submerged third".

These observations naturally lead to another one made the same winter in the two hundred bird pen of Reds. Two birds of equally good appearance from the egg-production standpoint were chosen to be studied one day. Every move of these two marked birds was followed all day long. The bird A bossed other birds thirty-three times and was bossed sixteen times. Bird B bossed thirteen other birds and was bossed thirty times. Bird

A spent 20.3 per cent of her time eating from the food
hoppers. Bird B spent 11 per cent of her time taking
snatches from the food hoppers before being driven away.
Bird A spent 32 per cent of her time wandering and
scratching in the litter. Bird B spent 61 per cent of
her time in like actions, and in avoiding other birds,
for she was a near-outcast. Bird A spent 48 per cent
of her time resting, which included a trip to the nest,
sitting on the nest perch, dusting in the litter and
perching on the roost. Bird B spent 24 per cent of her
time under this classification, most of which time was
spent wandering up and down the droppings board look-
ing for an opening at mash hoppers or drinking founts.
Just before dark she, like many of the others, wanted
a drink of water. She got two or three hasty swallows
on one attempt. She then came down from the roosts
two more times but was driven away each time and went
to bed thirsty. A laid 147 eggs to June 1 and B, 121
eggs. June 1 the hens were placed in non-trap nest
summer shelters. B had an inherited capacity to lay
judging by her efforts to make a living and by the
record which she made under the circumstances. But
she was one of those birds that invited trouble where-
ever she went.

It may be said that in these observations of large pens that few fights resulted from the almost incessant bossings. Again judging by the actions of the birds in the small pens it does not seem reasonable to think that the birds in the large pens would calmly receive bossings in an indiscriminate manner from any bird that felt like bossing them but that the birds that did the bossing either knew their victims "personally" or knew them as a type of bird that could be pecked.

In a pen of about sixty hens just finishing their first laying year, one bird was watched because she had just completed a 302-egg record. The birds had been in their new quarters for about two or three weeks. They had come from two summer shelters. By this time most of the fighting incident to the mixing of two pens of birds had ceased. The 302-egg hen was observed for about half an hour. She behaved exactly as any bird would in a small pen. She pecked and bossed many more birds than bossed her. She bossed without any hesitation those she did boss. Similarly those that bossed her did so without reservation. If there is not an order of dominance in pens of the size mentioned above there is some kind of a

situation or organization that bears all the earmarks of the closed order group.

So far as can be observed strangers that enter these larger groups have an introductory ceremony performed upon them, similar to that in the small pens, although no individual has been observed long enough at the Massachusetts State College to see what its ultimate destination was in the social scale.

Furthermore, the amount of space allowed each bird may have some effect upon the activities of the birds. Male B for a while was able to dominate his persecutors out in the yard (with the exception of R) following his defeat by R, but was absolutely at the mercy of them all when confined to the house, a few minutes afterwards.

In a discussion of the closed and open order organizations of fowl society what needs to be done, first, would be to see how many birds a closed order will include. Apparently many of the activities now described exclusively in one or the other will be found to co-exist in both. The observations described above would indicate that this was so.

SUMMARY

1. A definite order of dominance existed in every small pen of domestic fowl studied at the Massachusetts State College from 1922 to 1931.
2. The order of dominance may be of the simple, straight-line type. This is seldom encountered because of the many interacting factors affecting the position of an individual.
3. Reversals between individuals occur relatively infrequently, considering the number of paired relations involved, and are relatively decisive and permanent considering the smaller number of re-reversals.
4. Bossings and fights among the males are much more common and severe than among the females.
5. Most orders of dominance include many vicious circles, in some cases including every type of vicious circle from that of the three-member circle up to one that includes every member in the group.
6. The vicious circle, particularly the three-member type, has a very marked element of instability in it aside from the inconsistent

relation involved; for birds are very observing and apparently intelligent enough to take advantage of one bird bossing another.

7. Vicious circles, as elements of instability, are less common among the males. For the same reason, reversals, one of the corrections of the instability are much more common.
8. The observations indicate that the position of an individual in the order depends upon its inherited characteristics of disposition, ability at fighting, fighting equipment, size of body, earliness of maturity.
9. The position of an individual in the order also depends upon many environmental factors as for example, whether the bird is a stranger to the group or already established in it.
10. The condition of the fighting equipment, spurs and beaks, seemingly exert quite an influence in the case of the males, where relations are tested so much more frequently than in the case of the females.
11. The health of an individual is also a factor in the establishing and maintenance of the social

position. But, a temporary illness is not apt to cause a change. Sickness unto death even is sometimes unable to cause a change in the order.

12. The introduction of an individual to a closed group is formal in nature in spite of the excitement and fighting attending it. It is not a mob-like, free-for-all fight of the group picking on the stranger.
13. The introduction of the stranger to the group is very likely to result in the new-comer being forced to occupy a position at the foot of the scale if it does not become a complete outcast, temporarily or permanently.
14. The downfall of a "king" or "queen" is apt to be very revolutionary in its effects both upon the individual concerned and upon the group as a whole. In the case of the males it is very likely to result in death to the fallen member.
15. The ultimate position of an individual may hinge upon the attitude of the group toward it as well as upon its ability to dominate over every individual in the group.
16. In groups up to two hundred, indications of an order of dominance similar to that in the small

groups is evident in the actions of the individual members of these groups.

17. The order of dominance means much to the peace and contentment of the individual for with it go priceless privileges in the fowl social organization. The right to peck and boss the others is never considered lightly by the fowls. Some will fight to the death in the defense of it.

PART II

THE RELATION OF THE ORDER OF
DOMINANCE TO CERTAIN PHASES OF POULTRY HUSBANDRY

An Error in the Determination of Maturity. It would be surprising if some of the conditions existing in the order of dominance did not affect egg production and other factors which have to do with commercial poultry keeping. While this phase of the study of avian behavior has not been up to this time studied extensively, enough has been done to indicate that many managerial practices must be kept in harmony with these if most profitable results are obtained.

In the introduction to part one, it was mentioned that year after year Leghorn pullets placed in the laying quarters in a laying condition went out of production soon after being housed. If these birds, or a portion of them, failed to lay in a trap nest before going out of production, the date of maturity as determined by the trap nest would be a false one. The question may be raised as to how frequently such false determinations are made. An attempt will be made to answer this question on the basis of one hundred eight-five birds which were studied for this purpose.

During the three seasons of 1926-1927, 1928-1929 and 1930-1931, eighty-five Leghorn pullets, fifty Rhode Island Reds and fifty Barred Plymouth Rocks were judged for maturity. A large percentage of these pullets were especially selected on the range to be about ready to lay. This was done by one of the instructors at the Massachusetts State College who teaches judging and knows by much experience when a bird is about ready to lay. For a good many years the author of this thesis has upon housing pullets, estimated within how many months each would start laying. These one hundred eighty-five pullets were each judged in this manner and weighed when placed in the laying quarters. Except for the birds which were retarded for a month or more beyond the time when it was predicted they would start laying, the predictions averaged to coincide with the day of the first egg laid in the trap nest within two or three days. It was in all cases attempted to make the estimate generous in the amount of time it would take the bird to mature. It therefore may be concluded that any appreciable delay beyond the estimated date of the first egg in the trap nest would be due to the bird being retarded by

some factor related to the order of dominance, to laying the eggs on the floor instead of in the nest, or to some pathological condition. It is believed that most of the retarded maturity dates were due to some form of bossism.

A summary of these retarded individuals for the three seasons is here presented by breeds. Eighteen of the eighty-five Leghorn pullets had retarded maturity dates beyond that prophesied as follows: 9 for one month; 4 for two months; 1 for three months; 1 for four months; 1 for six months; and 1 for seven months. Only those birds are included that did start laying within eight months of the time prophesied. No birds dying during this time were included. It is believed that a certain portion of the outcasts die from the abuse they receive or from starvation.

Sixteen of the fifty Rhode Island Reds had retarded maturity dates as follows: 10 for one month; 2 for two months; 1 for three months; 2 for four months; and 1 for five months.

Fifteen of the fifty Barred Plymouth Rocks had retarded maturity dates as follows: 10 for one month; 2 for two months; 1 for three months; and 2 for four months.

In percentages this made twenty-one per cent of the Leghorns having a false maturity date of from one to seven months; thirty-two per cent of the Rhode Island Reds; and thirty per cent of the Barred Plymouth Rocks. Of the eighteen retarded Leghorns, seven were from the pen of twenty-five pullets over which Y₂ ruled so imperiously (See Part I). It is believed that this one pullet had a large share in retarding these seven birds.

The following observation is pertinent to these findings. The bird retarded for seven months was in a laying condition when housed; so was the one retarded for six months. The one retarded for five months was predicted to come into laying within one-half of a month. The five birds retarded for four months had predictions as follows: 1 for one-half month, 1 for three-quarters of a month, 2 for one and one-half months, and 1 for two months.

One more observation throws light upon this phase of the matter. W₂, the only pullet in the 1930-1931 project to be retarded, and that for four months (See Plate II), was seen to lay one egg on the floor the first day she was in the laying pen. As Plate II indicates, she then proceeded to go through a rather

complete molt, molting five primaries in addition to the body feathers. This is a very typical reaction of a bird that is thrown out of production. But for having seen this bird lay her egg on the floor, she would have been put down in the breeding records as having matured on January 16th instead of on September 18th, or earlier as she may have been laying for sometime on the range.

The numbers, while not large, indicate a condition that not only caused the mis-labeling of some birds for maturity but also a loss of eggs when eggs are the highest in price. Can anything be done about it?

A graduate of the Stockbridge School of Agriculture wrote the following in a letter to the author: "I sold twelve or thirteen runt pullets as meat birds among some male broilers. The man kept these pullets against my advice and they laid fifty per cent or better all winter, going over sixty per cent at times. I saw some of these pullets late in the spring. They were good looking and apparently weighed around five pounds each". These were Rhode Island Reds.

The writer had occasion to separate a flock of about one hundred Leghorn pullets into two flocks. About a third of the most abused and immature birds

were put into a pen by themselves. It was surprising how soon those birds got into production and how well they laid.

It is believed that on a large poultry plant the taking out of ten to twenty per cent of the smallest and most abused pullets soon after they are housed and the putting of these together in a separate pen will show improved egg production of those so segregated. But the birds so moved should be moved all at the same time, reasons for which, if not already apparent from a study of Part I of this paper, will be made so in what follows.

One Reason Why Moving of Birds Affects Egg Production.

The effects of the introduction of strange birds into established close order groups has been discussed in Part I largely from the standpoint of the effect upon the individual bird's standing in the order of dominance. At this point a practical application of this will be made.

On most breeding plants a certain percentage of pullets are used as breeders. There are many good reasons for doing this. It is sound practice. But unless the poultry breeder obtains more information

than he now possesses he cannot at housing time predict which of the pullets are going to pass the tests which will permit them to make a breeding pen.

Therefore, if a bona-fide breeding program is carried on, involving single male matings, more or less moving of the pullets becomes necessary. Of course, stud mating may be used, but not many breeders find this satisfactory and even where this is employed the pullets are frequently moved to a special pen fitted up with the male stud coops.

The pullet breeding candidates must not be moved in a haphazard manner. They must be moved as nearly as possible at the same time, within two or three days of each other, better all on the same day. To spread the moving period over a week or more is to invite much trouble as a consideration of the formal introduction of the stranger described in Part I must indicate. Let us see what did happen under certain known conditions of moving pullet breeders.

In the 1929 breeding season at the Massachusetts State College teaching Poultry Plant (not the Experiment Station Plant), two groups of Rhode Island Red pullet breeders were chosen. Twenty-one of these remained in several pens of about twenty-five birds

each where they had been placed in the fall. Of these, one bird ceased laying for fourteen days or more before February 1, the day the second group of breeding pullets were moved into new quarters. This fourteen-day cessation of laying will be called hereafter, a pause. It must not be confused with the four-day pause reported by Dr. F. A. Hays. It was decided to use a fourteen-day pause to be sufficiently large for this study and as being less apt to be due to causes other than bossism. This left twenty pullets to be considered further. Of these twenty, fourteen did not pause during the month of February. Six averaged to pause 14.3 days each during February. The twenty averaged to pause 18.5 days each during February, March and April.

The second group of Red pullets, nineteen in number, were moved into the pens containing the first mentioned group of established pullets from all over the plant. From one to four birds were placed in each of the established pens. Of these, five had paused before the moving date and therefore are not considered. Only one of the fourteen pullets did not pause during February. The thirteen averaged to pause twenty-four days during February. The fourteen averaged to pause forty days each during February, March and April.

In the 1932 breeding season, three groups of Rhode Island Red pullets were recorded for pauses. The first group remained in the pens where they were placed in the fall. These totalled seventeen pullets. Of these, one bird paused before January 18th, the mean moving date for 1932. Of the sixteen remaining pullets, fourteen did not pause from January 18th to February 29th. Two birds averaged to pause nineteen days each for this period. The sixteen birds averaged to pause 3.6 days each for the period from January 18th to April 30th.

The second group of breeding pullets were moved into three empty pens from January 17th to 19th. Of the thirty-eight birds so moved, four had paused before January 18th. Of the thirty-four remaining birds, twenty-nine did not pause from January 18th to February 29th. Five birds did pause an average of twenty-four days each for the forty-two day period. The thirty-four birds averaged to pause 9.8 days each from January 18th to April 30th.

The third group of thirty-four breeding pullets were moved into a stud-pen containing eighteen established old hen breeders. Two of these thirty-four paused before being moved. Of the thirty-two

remaining birds, nine paused an average of 24.4 days during the forty-two day period ending February 29th. Twenty-three did not pause during this period. The thirty-two birds averaged to pause fifteen days each for the period from January 18th to April 30th.

The pauses of the above five lots of breeding birds may be summarized in terms of percentages as follows:

First 1929 group, remained in established pens; 70 per cent did not pause in February.

Second 1929 group, moved into established pen as strangers, only 7 per cent did not pause in February.

First 1932 group, remained in established pens; 87 per cent did not pause from January 18 to February 29.

Second 1932 group, moved into empty pens, all strangers to each other; 82 per cent did not pause from January 18 to February 29.

Third 1932 group, moved into a pen containing a small number of established hens; 72 per cent did not pause from January 18 to February 29.

The nearer the condition approaches that of but one bird entering an established pen as a stranger, the larger the percentage of birds so introduced that will be thrown out of production.

It is quite evident that the method of moving has much to do with the egg production of the birds moved. There is no time when continued egg production

is more desired than during the breeding season. The loss of eggs in the second group of 1929 was not only most serious from the standpoint of the reduced number of chicks obtained from this group; it also made it impossible to judge the breeding value of many of these birds because of the few chicks or none obtained from them.

The Relation of Dominance to Feeding. A breeder of Rhode Island Reds in Massachusetts reported that providing 16 running feet of mash hopper space instead of eight made possible as good egg production as eight feet with lights. From this one would conclude that the chief value of lights was in allowing the bossed birds more time in which to eat. Furthermore, it has been frequently observed that unless some treat like a wet mash awaits the birds, that comparatively few come down to eat when the lights are turned on for an evening lunch. Therefore, plenty of food hopper space is necessary if all the birds are going to get enough to eat.

The Relation of Dominance to Selection of Breeding Males. Many breeders advocate the selection of "cocks-of-the-walk" to head up breeding pens.

Sanctuary (1929) reported observations in the so-called bull pens where males are kept until the breeding season. Many males that are well grown and with desirable dispositions from the standpoint of modern commercial poultry keeping do not survive the continued harrassing by males of superior fighting ability and mean dispositions. There is no question but that such a method would be ideal if one were selecting breeding males for the cock pit. But granting that cocks of the walk are always desirable, when is a cock a cock of the walk? (See Part I, Plates V-VII).

The Interplay of Instincts When Birds are Driven. One more observation will be described which may have some value. It may or may not have some relation to the laws of social intercourse in avian society. In 1914 the author had occasion to move some ten-weeks old chickens a distance of about four rods. As a precaution the birds were shut up in their new abode for a day or two. In the meantime, the old colony house had been moved. The night of the day when the chickens were again let out they were found that evening roosting on the ground where the old house had been. Because of the danger from foxes those chickens had to be moved

into the new colony house. By aid of a lantern and two hours of patience those chicks were finally housed. But a new principle of chicken behavior was noticed. When a stranger, the poultry manager in this case, got too close to the chickens they began to scatter. When the stranger withdrew a short distance, continuing to talk to them, they began to clump together again. By alternating the advances with the vocal retreats the chickens were finally gotten into the house.

This method was later applied several times in the fall in driving the Leghorn pullets from the range to the laying houses, one thousand or more feet away. Two or three students and the teacher, each armed with two sticks, made the driving element appear very wide to the driven pullets. The alternating advances and short retreats would always keep the pullets together and moving in the desired direction.

Is this action due to a nice balancing of fear and the innate desire to be close to one another? When the enemy gets too close, do the hens in desperation finally lose faith in the protection afforded by the group and each, therefore, start out on his own? Does the retreating enemy then lessen the fear to the extent of permitting the urge for one another's society to become uppermost with the consequent clumping together again? Anyway, this principle works in practice.

SUMMARY

1. The order of dominance as the essential element in the organization of fowl society has its application in commercial poultry husbandry practices.
2. Because of the effects of bossism, that is, the abuse of a certain portion of each flock by the other hens, and especially by those of domineering dispositions, at the time of housing the pullets, from twenty to thirty per cent of these were retarded in maturity from one to seven months as measured by the first egg laid in the trap nest. This has been observed to occur among Reds, Rocks and Leghorns. These false maturity dates affect both commercial results and the breeding program.
3. It is believed that the effect of this retardation in maturity may be partially overcome by removing from each pen a week or so after housing from 10 to 20 per cent of the smallest and most abused birds and putting these birds together in a pen by themselves.

4. Because of the fighting for a position in the order of dominance which invariably takes place when strange birds are introduced into a pen and because of the consequent abuse such birds frequently receive as outcasts or near-outcasts, the method of moving birds should be such as to put all birds so moved on a common footing. When birds have to be moved as during the breeding season and from the range all birds going into a pen should be moved at the same time and be either all strangers to each other or all known to each other. For orders of dominance must first be settled by every inmate of the newly constituted pens before any other business of eating or laying is properly taken care of. To ignore this principle will cause cessation of laying of a rather large portion of the birds so mishandled.
5. Plenty of feeding and watering space should be allowed each bird if the effects of bossism are to be kept down to a minimum.
6. Selecting cocks of the walk does not always result in the perpetuating of the most desirable

social traits in the commercial flocks of laying birds. More discriminating criteria should be employed.

7. The balance between the gregarious instinct of birds to keep in one another's company and that of scattering due to fear upon the near approach of an enemy may be maintained in favor of the grouped condition when driving birds by the alternation of approaches and of short retreats on the part of the drivers.

BIBLIOGRAPHY

Alveredes, Fr.

1927 "Social Life in the Animal World."

Fabre, J. Henri C.

1912 "Social Life in the Insect World."

Fischel, W.

1927 "Beiträge zur Soziologie des Haushuhns.
Mit 2 Abbildungen. Biologisches
Zentralblatt." Vol. 47.

Fronza, F. M. and Paje, P. S.

1930 "Observations of the Activities of Fowls
in the Laying House." The Philippine
Agriculturist (August).

Holmes, S. J.

1916 "Studies in Animal Behavior."

Katz, D.

1922 "Tierpsychologie and Soziologie des
Menschen". (Zeitschr. f. Psychol., vol.
88).

Rogers, C. A.

1912 "Effects of Mixing Pens of Birds". Cornell
Bulletin 318, Constitutional Vigor. Page
318.

Sanctuary, Wm. C.

1929 "Too Many Bosses". American Poul. Journal,
Vol. 60, No. 11, November 1929.

Schjelderup-Ebbe, Th.

1922 "Beiträge Zur Sozialpsychologie des Haushuhns"
(Zeitschr. f. Psychol., Vol. 88).

Wheeler, W. M.

1930 "Social Evolution". Human Biology and
Racial Welfare by E. J. Cowdry, Chapt. VI.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation of the material assistance and many courtesies extended him by his "boss", Professor J. C. Graham and his associates in the "open-order" poultry department, in which, as in the similar social order of the domestic fowl, the instinctive urge to lead on the part of every individual has been encouraged to find expression in original lines of study.

Approved by:

J C Gialan

Gene E. Cauer

H. H. Geis

Graduate Committee

Date June 13, 1932

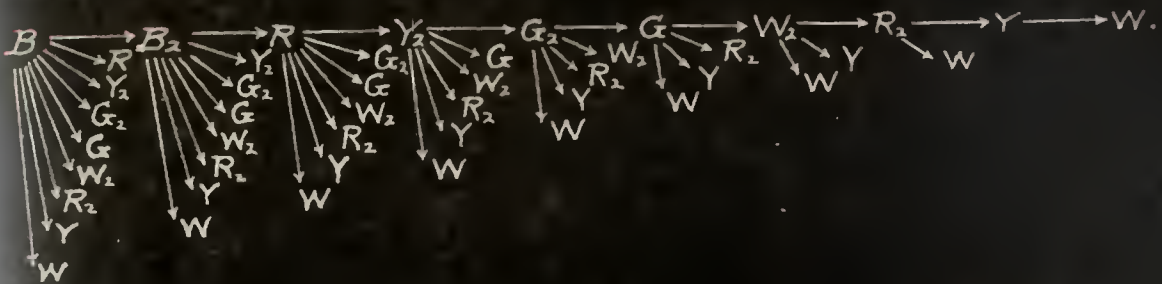
PLATE I.

THE LESS FREQUENT ORDERS OF DOMINANCE

1. The stable "straight-line" relation. (Schjelderup-Ebbe).

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow I \rightarrow J.$$

2. A more complete illustration of the straight-line relation taken from a pen of males at the Massachusetts State College, Jan. 17, 1931. No vicious circles possible.



3. An illustration of a combination of straight-line and vicious circle relations reported by Schjelderup-Ebbe.

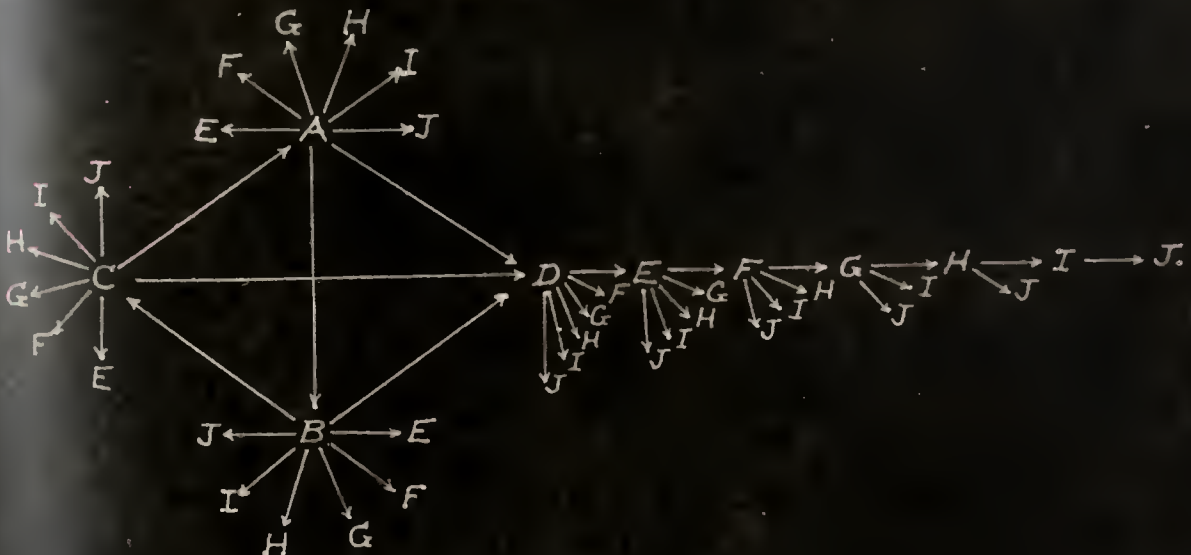
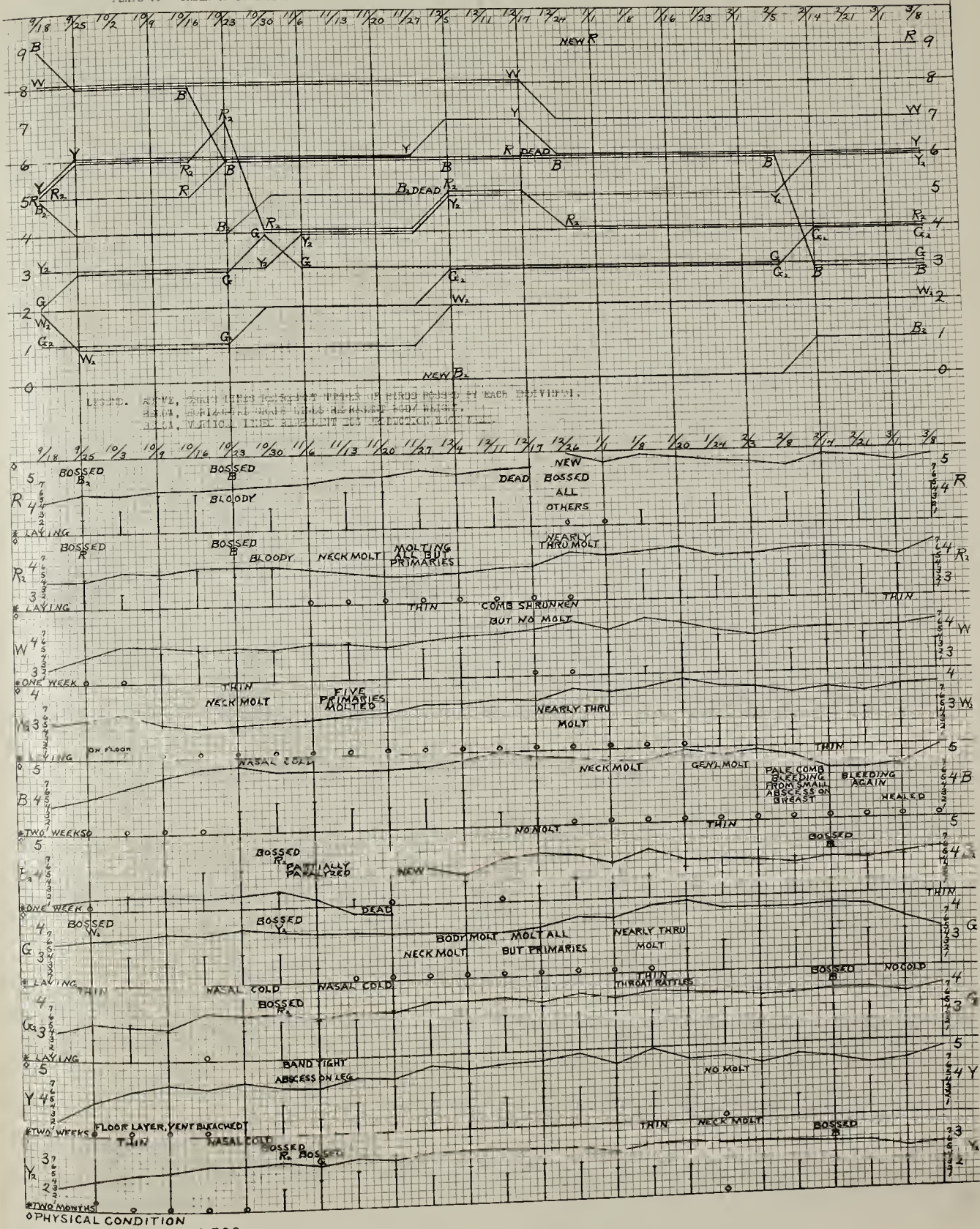
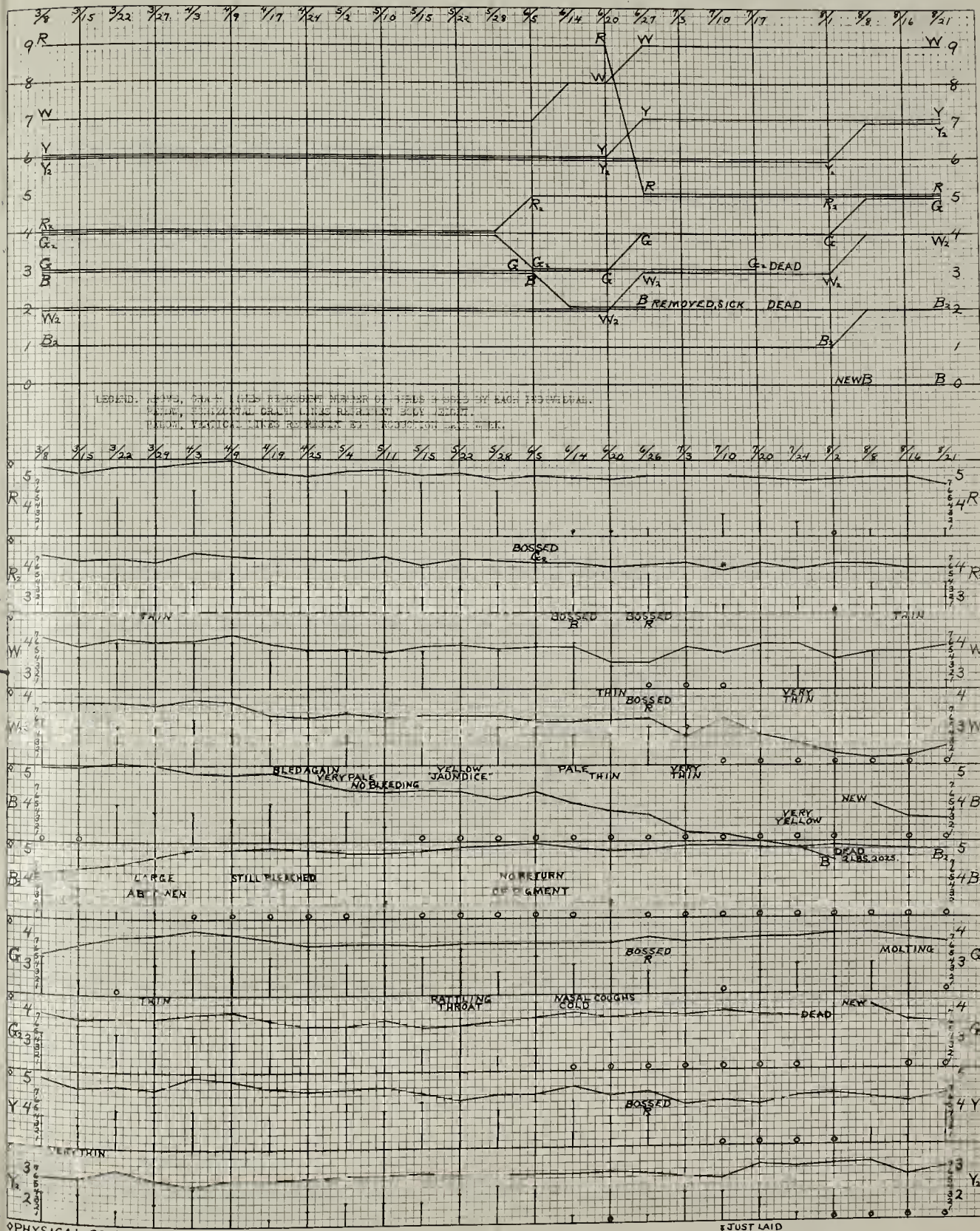


PLATE II - ORDER OF DOMINANCE IN RELATION TO BODY WEIGHT AND EGG PRODUCTION, WHITE LEGHORN FULLETS, 1930-1931.





PHYSICAL CONDITION

JUST LAID

TABLE IV - TABLE OF PHYSICAL CONDITION IN ALL BIRDS BY WEIGHT AND AGE REDUCED, WHITE LEGHORN CHICKENS, 1930-1931.

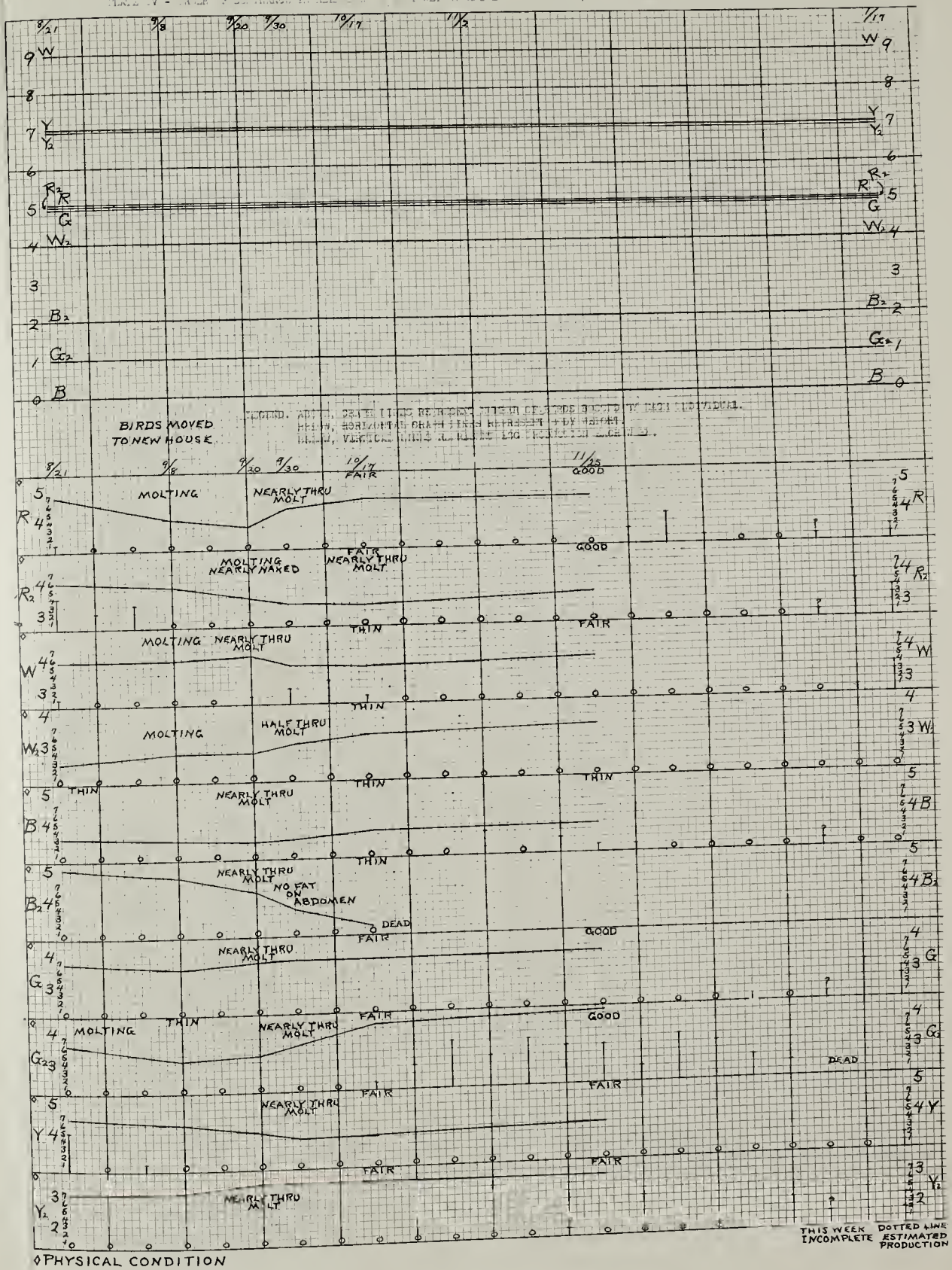


PLATE V - ORDER OF DOMINANCE IN RELATION TO BODY WEIGHT, WHITE LEGHORN COCKERELS, 1930-1931.

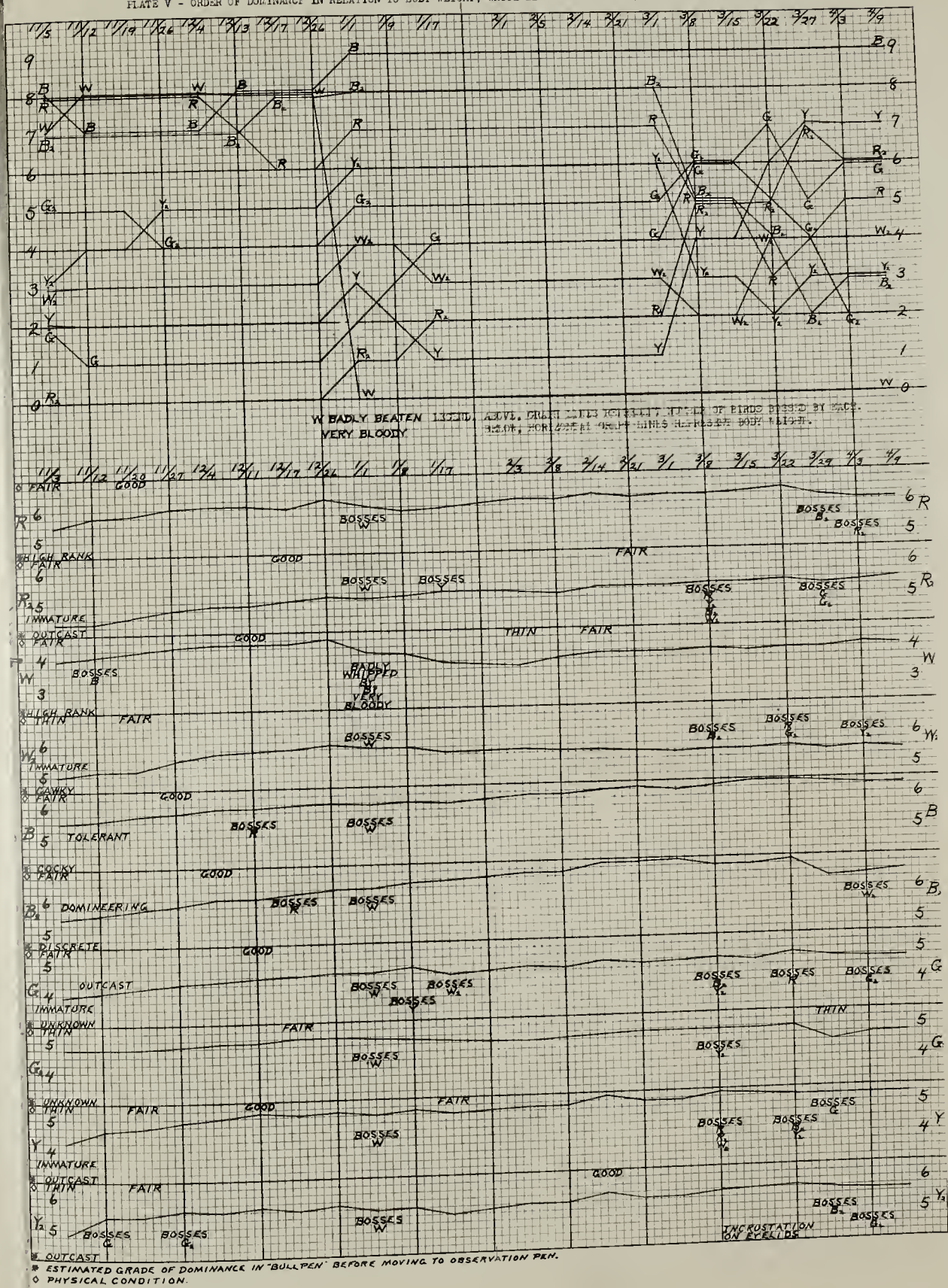
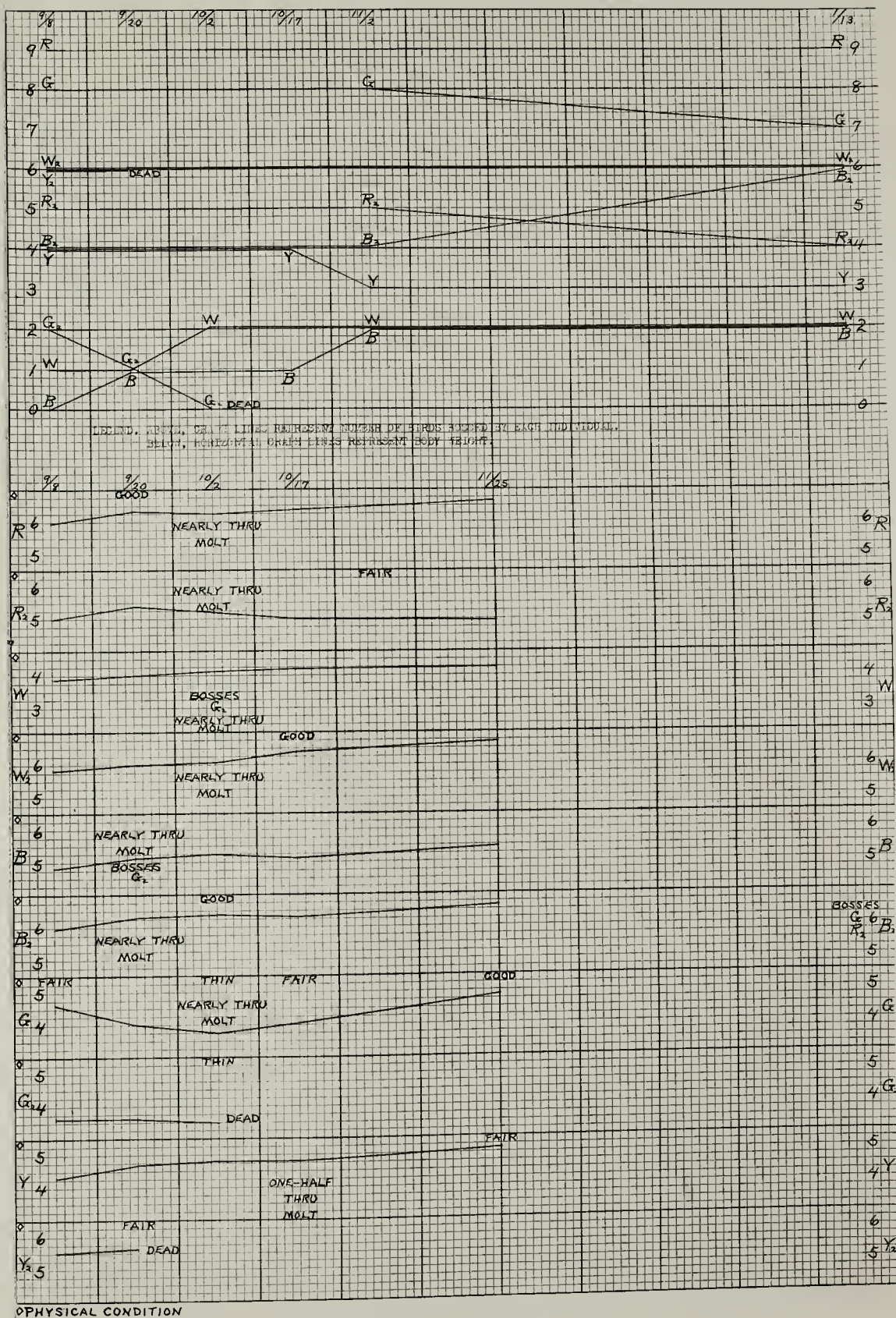


PLATE VI - ORDER OF DOMINANCE IN RELATION TO BODY WEIGHT, WHITE LEGHORN COCKERELS, 1930-1931.



*FEED HOPPERS EMPTY

PLATE VII - ORDER OF DOMINANCE IN RELATION TO BODY WEIGHT, WHITE LEGHORN COCKERELS, 1930-1931.



PHYSICAL CONDITION

Page 15

AVIAN DISPOSITION STUDIES - BOSSING OBSERVATIONS

Names of observers

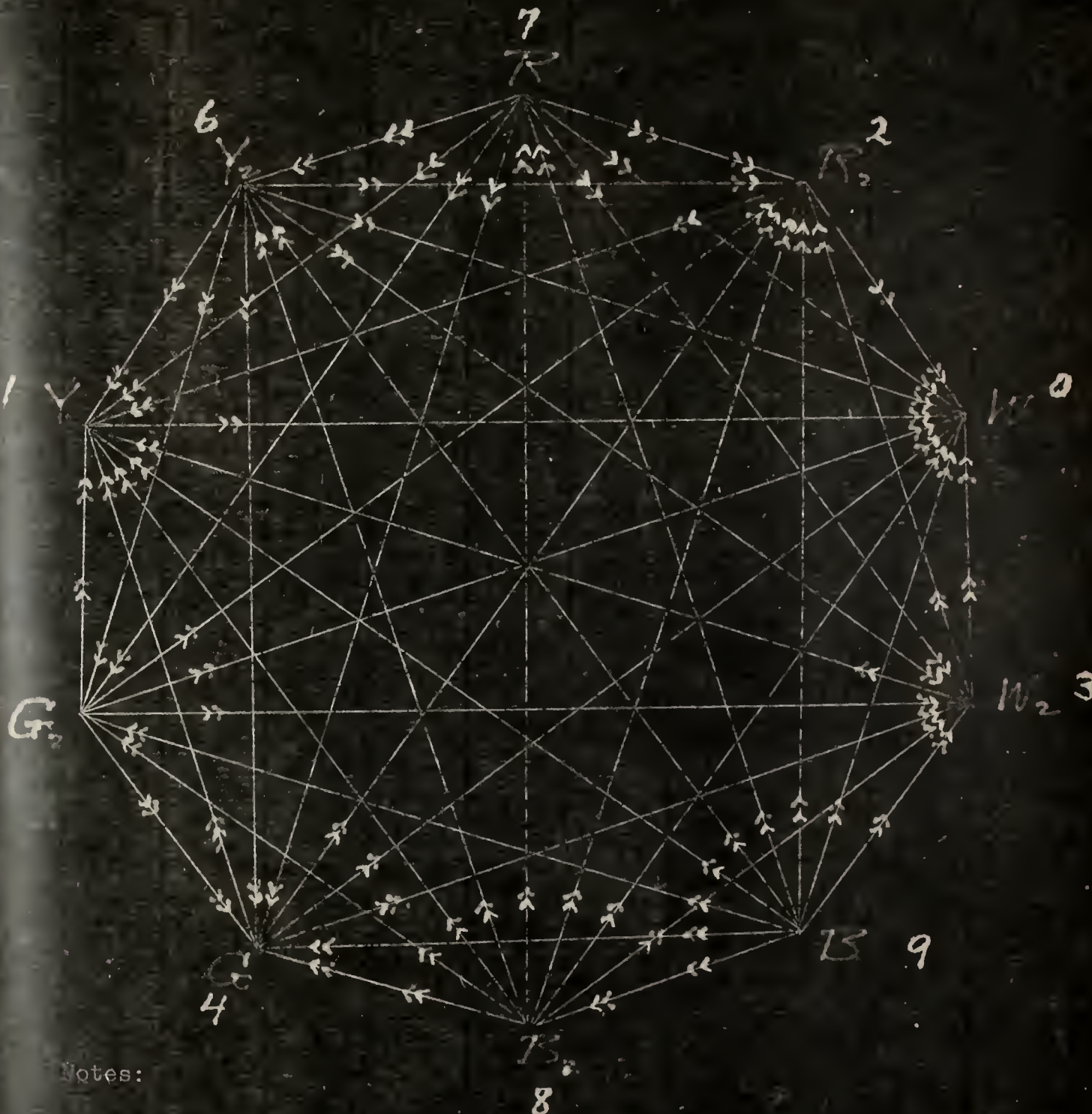
Wm. C. Anthony

Date

Feb. 14, 1931

Hours

3:46 P.M.



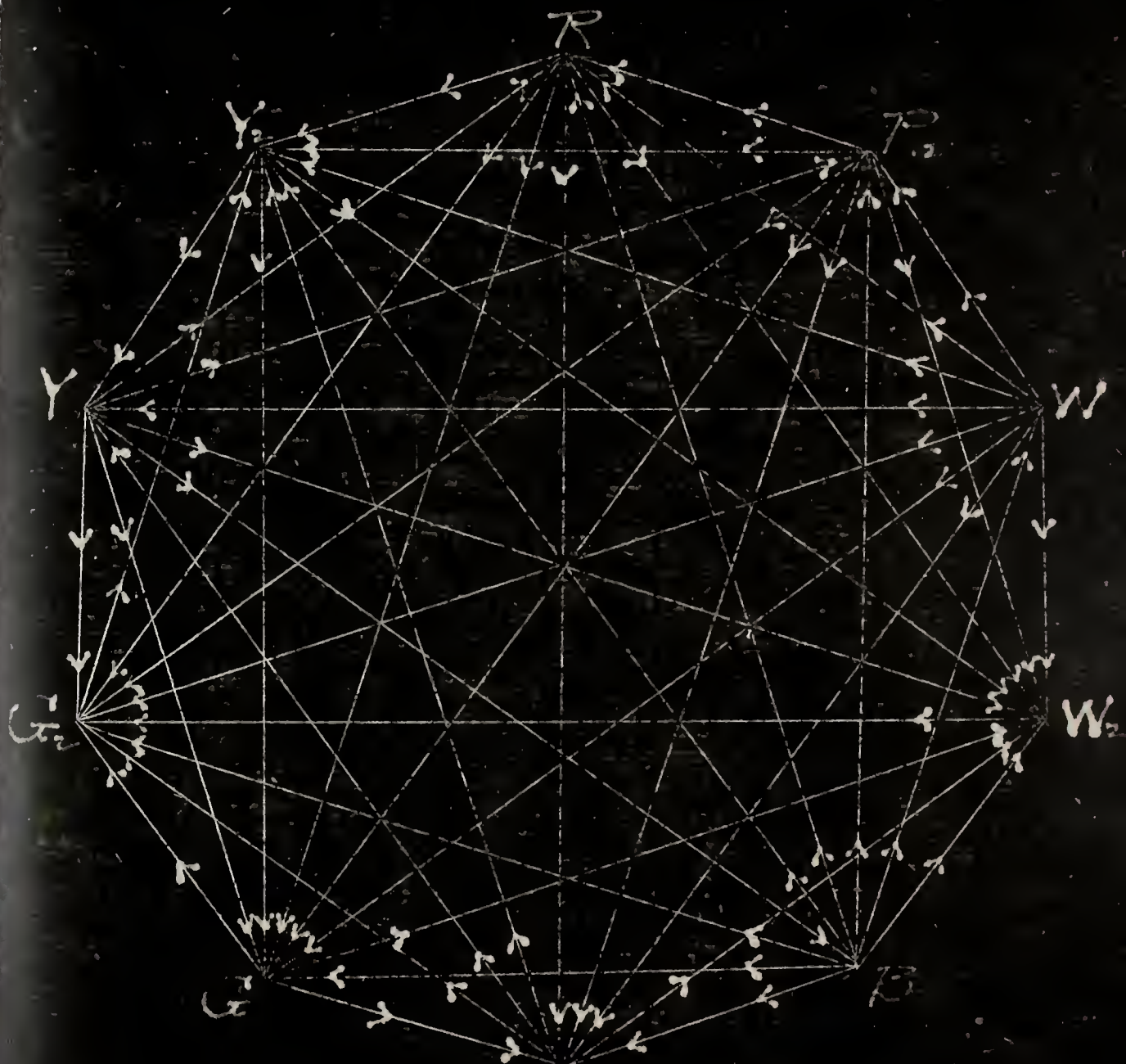
Names of observers

E. M. C. D. Rustumany

to *Oct. 9, 1950*

VICIOUS CIRCLES.

Hours *4-5 P.M.*



Notes: VICIOUS CIRCLES *B.* EXAMPLES.

13 - 3-member circles

$R \rightarrow B_2 \rightarrow Y \rightarrow R$

21 - 4 -

"

"

$W_2 \rightarrow G_2 \rightarrow Y_2 \rightarrow Y \rightarrow W_1$

35 - 5 -

"

"

$B \rightarrow G \rightarrow G_2 \rightarrow Y_2 \rightarrow Y \rightarrow B$

37 - 6 -

"

"

$W \rightarrow B_2 \rightarrow G_2 \rightarrow Y_2 \rightarrow Y \rightarrow B \rightarrow W$

29 - 7 -

"

"

$R_2 \rightarrow G \rightarrow G_2 \rightarrow Y_2 \rightarrow Y \rightarrow B \rightarrow W \rightarrow R_2$

14 - 8 -

"

"

$R \rightarrow Y_2 \rightarrow G \rightarrow B_2 \rightarrow Y \rightarrow B \rightarrow W \rightarrow R_2 \rightarrow R$

5 - 9 -

"

"

$R_2 \rightarrow W_1 \rightarrow G_2 \rightarrow Y_2 \rightarrow G \rightarrow B_2 \rightarrow Y \rightarrow B \rightarrow W \rightarrow R_2$

1 - 10 -

"

"

$R \rightarrow W_1 \rightarrow G_2 \rightarrow Y_2 \rightarrow G \rightarrow B_2 \rightarrow Y \rightarrow B \rightarrow W \rightarrow R_2 \rightarrow R$

Notes - 24

AVIAN DISPOSITION STUDIES - BOSSINGS OBSERVATIONS

Names of observers *Wm. P. Slaughter*

Date *May 9, 1931*

LEGEND:

DARK ARROW > = LAST WEEK'S RELATIONS.

LIGHT ARROW > = THIS WEEK'S RELATIONS.

Hours *10:30 A.M.*



Notes:

Wavy lines = reversals.

Situation still tense. Much challenging and scrapping between individuals to test order of dominance. $W_2 \rightarrow R$, $W_2 \rightarrow W$, $Y \rightarrow Y_2$, G_2 vicious toward B.

Names of observers Wm. R. Punctum

Date Nov. 29, 1930

NO "QUEEN" SITUATION

Hours 4:20 P.M.



Notes:

No change since Nov. 6.

TWENTY-TWO TRI-MEMBER
VICIOUS CIRCLES ON
THIS DATE.

B₂ ← KILLED BY ATTENDANT ON
MORNING OF NOV. 25.
HELPLESS ON FLOOR
'PARALYSIS'

PLATE XIII.
THE WHITE LEGHORN FEMALES
(Pictures taken early in September, 1931)

Note the attitudes taken by the superior and inferior birds.



W bossed W_2 more than any other bird all through the year.



B_2 assumed the attitude of the dominant hen.



Y_2 tried to look big. She had a disposition to match her bluff.



Although molting G retained her social position.



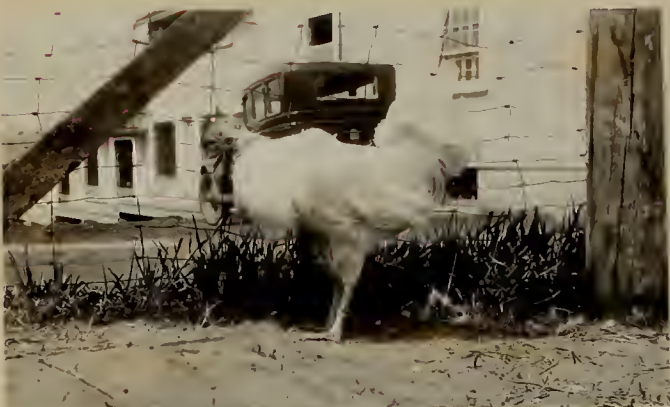
Big R, a dominant bird with a good disposition.

Note: Arrows indicate the relation between each pair of birds.

PLATE XIV.

THE WHITE LEGHORN MALES

(Upper four pictures taken in May, 1931)
(Lower two pictures taken in August, 1931)



B, a defeated monarch. His face is still swollen from the terrific battle with R.



W, on right, about to resume his "courting" of B, recently dethroned.



R, the victor over B, but still over two months away from becoming "cock of the walk".



Y, very high strung, became king after R defeated B.



W₂, an effeminate looking and acting male. Stately G₂ in left background.



Left to right, G, Y, R, B₂, R₂, W. Two others do not show enough for their identification.

Approved by:

Graduate Committee

Date _____

